SAE JOURNAL

NOVEMBER
1953

IN THIS ISSUE . . .

PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS

Here's the way it adds up:

25 out of 27 leading engine manufacturers

using chrome rings specify Perfect Circle

The Standard of Comparison

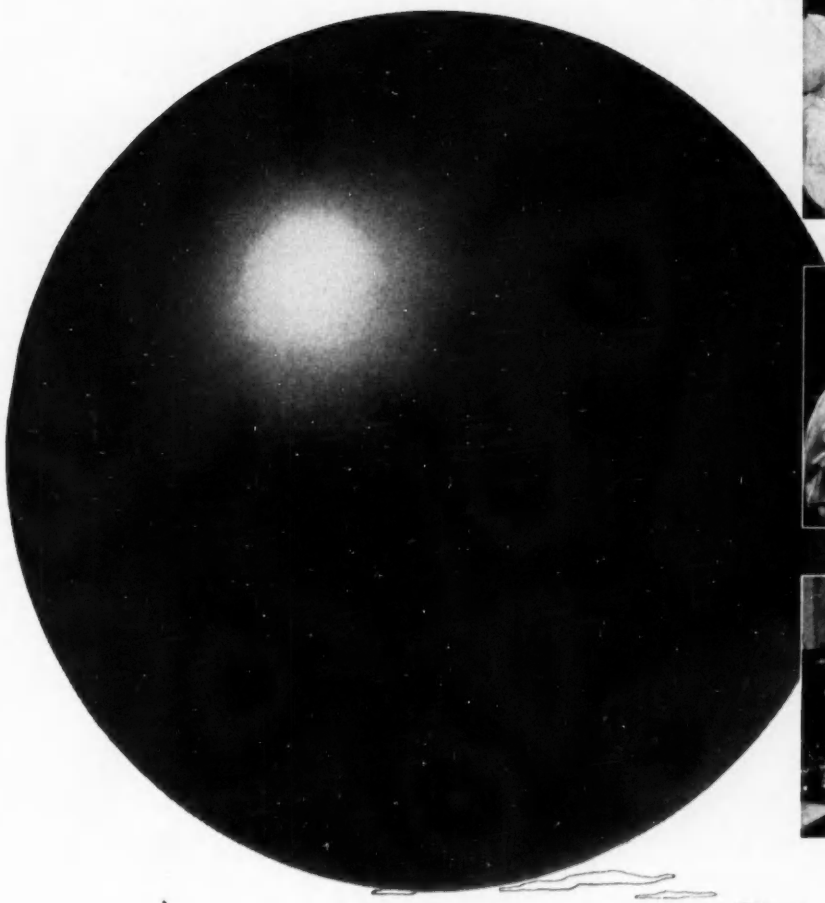
The application of solid chrome plating to piston rings, as perfected by Perfect Circle, more than doubles the life of pistons, rings and cylinders. Performance data will be furnished on request. Write Perfect Circle Corporation, Hagerstown 3, Indiana; The Perfect Circle Co., Ltd., Toronto, Ontario.

Precision in mass production

Miniature bearings are gauged and classified to meet various tolerance specifications.

Visual check under magnification . . . one of many exacting inspections.

Ultrasensitive torque testers measure starting characteristics of low torque bearings.



To keep pace with the ever increasing requirements of modern instrumentation, New Departure has greatly multiplied its miniature bearing production . . . built the nation's most modern facilities at Sandusky, Ohio.

Here is careful craftsmanship, infinite inspection, perfection in precision, on a mass production scale never before achieved. Here are the latest machine tools, the most advanced testing and inspection devices, many of which had to be specially designed by New Departure.

For a personal introduction to these fine new facilities, send for your free copy of our new fully illustrated booklet on New Departure instrument bearings.

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE

BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Plants also in Meriden, Connecticut, and Sandusky, Ohio

SAE JOURNAL, November, 1953, Vol. 61, No. 11. Published monthly by the Society of Automotive Engineers, Inc. Publication office at 10 McGovern Ave., Lancaster, Pa. Editorial and advertising department at the headquarters of the Society, 29 West 39th Street, New York 18, N. Y. $1 per number; $10 per year; foreign $12 per year; to members 50 cents per number, $5 per year. Entered as second class matter, September 15, 1948, at the Post Office at Lancaster, Pa., under the act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d-2), Sec. 34.40, P. L. and R., of 1948. Additional entry at New York, N. Y.

NATIONAL OIL SEAL LOGBOOK

Sealing News & Tips

Write our Redwood City office for reprints of this Logbook page

How Dart uses National O-Rings in front end suspension of 60-ton truck

Among the many unusual features of the new Dart 60-ton dump truck is the air-hydraulic suspension system for the front axle.

As the dual 18.00 x 25 tires roll into a depression, the fixed piston (Figure 2) moves downward. This forces S.A.E. #30 mineral oil from the piston chamber to the hollow piston and compresses captive air above the oil level. As the truck's weight presses downward, the operation is reversed. In both cases, counter-pressure between air and oil absorbs road shocks.

To insure zero leakage sealing in this demanding application, four National O-Rings are employed. Three O-Rings seal various piston or cylinder parts, and a fourth seals the oil intake valve. O-Ring diameters range from approximately 16" on the piston cap to 1" on the intake valve. O-Rings are all conventional National synthetic rubber O-Rings, designed to withstand temperatures up to 300° F and pressures to 1,500 p.s.i.

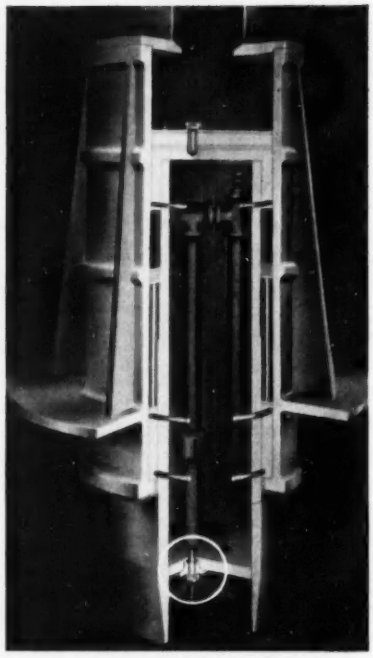


Figure 2. Dart Front End Suspension Unit

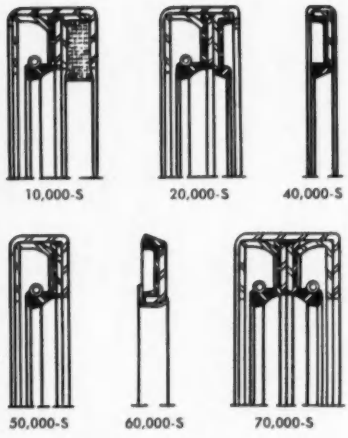
Figure 1. Dart Model 60 Truck

Standard-design National Oil Seals with single and dual spring-tensioned sealing lips (Figure 3) are also utilized in the truck—particularly in the wheel bearing assembly, planetary clutches and twin 350-horsepower engines.

Figure 3. National 50,000 (left) and 10,000 spring-tensioned leather oil seals

Precision-made National Oil Seals and O-Rings are available in thousands of standard types and sizes. If conventional units do not precisely suit your application, modified or special seals can be designed. Call the factory-trained National Applications Engineer nearest you for complete information.

Standard-design National Syntech* Oil Seals are widely used for zero leakage operation in applications where intermittent temperatures reach 300° F, speeds reach 3,600 F.P.M., and total indicator runout reaches .030. These basic designs employ tough, accurately manufactured steel outer cases, precision-tensioned springs and accurately molded and trimmed Syntech sealing lips unaffected by water, most lubricants, detergents or industrial fluids.



"Let Your Decision be Based on Precision"

NATIONAL
OIL & GREASE SEALS
O-RINGS SHIMS

NATIONAL MOTOR BEARING CO., INC.
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Plants: Redwood City, Calif.; Downey (Los Angeles County), Calif.; Van Wert, Ohio

*T.M. Reg.

2914

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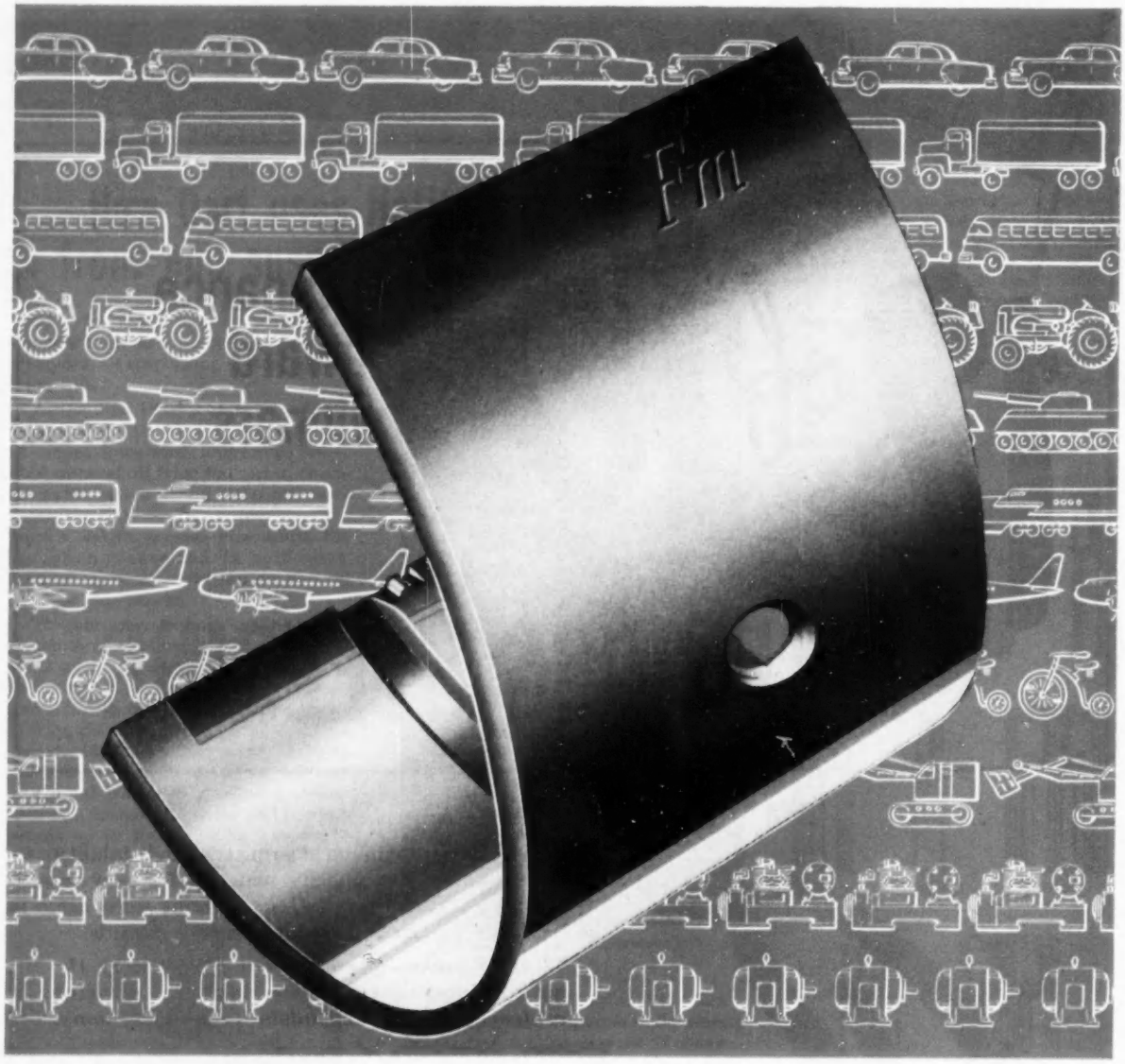
DETROIT, MICH. . . . . *726 Lothrop Avenue, TRinity 1-6363*
DOWNEY (Los Angeles Co.), CALIF. . *11634 Patten Rd., TOpaz 2-8166*
MILWAUKEE, WIS. . . *647 West Virginia Street, BRoadway 1-3234*
NEWARK, N. J. . *Suite 814, 1180 Raymond Blvd., MItchell 2-7586*
REDWOOD CITY, CALIF. . . *Broadway and National, EMerson 6-3861*
WICHITA, KANSAS . . . . *519 South Broadway, WIchita 2-6971*



A Dependable Service for Over 50 Years

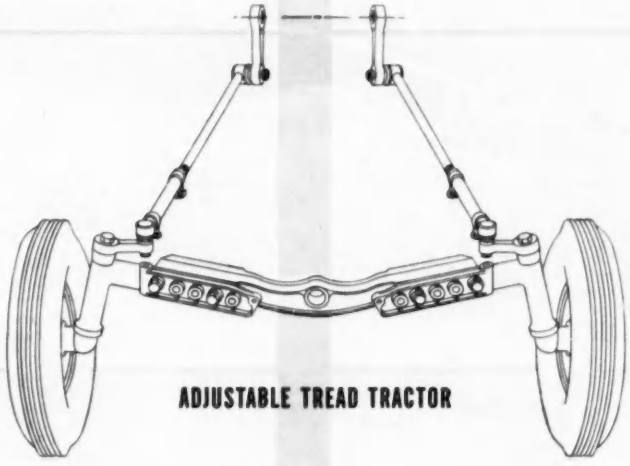
Sleeve bearings in a wide variety of designs and sizes; cast bronze bushings; rolled split-type bushings; bimetal rolled bushings; washers; spacer tubes; precision bronze parts and bronze bars.

FEDERAL-MOGUL CORPORATION 11035 Shoemaker • Detroit 13, Michigan

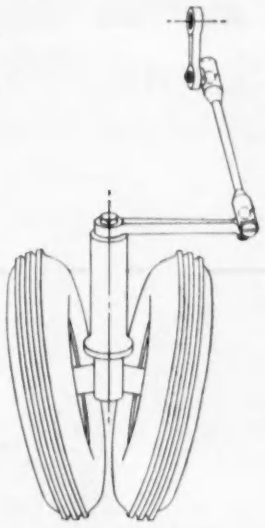
FEDERAL Mogul

FEDERAL-MOGUL

Engineered Steering for Tractors



ADJUSTABLE TREAD TRACTOR



TRICYCLE TYPE TRACTOR

CENTER ARM STEER
Adjustable Tread Tractor

STEERING LINKAGE must be developed to meet the requirements of many different tractor designs. Thompson's "Steering Engineers" have worked closely with tractor builders for many years to improve steering.

With the accent on easy steering, design advances, maneuverability and increased loads on the suspension and linkage; steering linkage units are required to provide more strength and accuracy and greater freedom of movement at the sockets.

Improvements in modern tractors—requirements by many tractor manufacturers for improved steering to accommodate adjustable front wheel tread for planting and cultivating certain types of farm products—necessitated better and far more complicated steering units.

Illustrated are 3 of the types of steering linkage found on current-model tractors. Thompson Products makes a wide variety of such parts. For consultation on these designs or other steering problems, please contact us.

YOU CAN COUNT ON...

Thompson Products, Inc.

MICHIGAN PLANT
DETROIT • FRUITPORT • PORTLAND

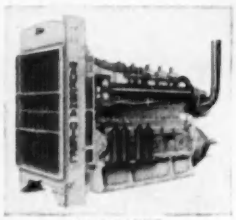
WAUKESHA

ENGINES and POWER UNITS—10 hp.-570 hp.

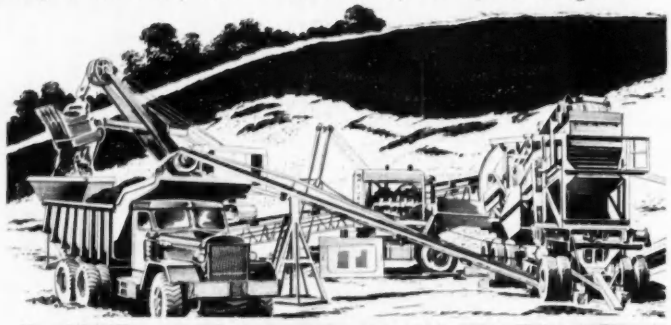
Normal and Turbocharged Diesels, Gasoline, Natural Gas, LPG
Standard or Counterbalanced Crankshafts

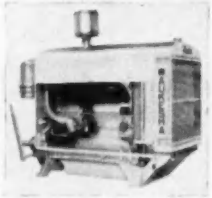
WAUKESHA MOTOR COMPANY, Waukesha, Wis. • New York, Tulsa, Los Angeles

Model 135-GZB

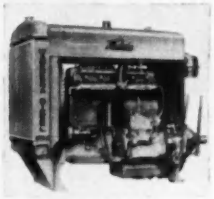


Model LRDS

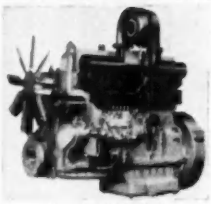




Model 135-GKB



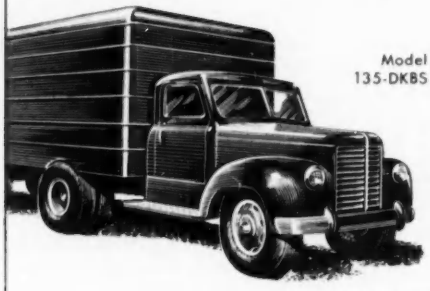
Model 148-DK



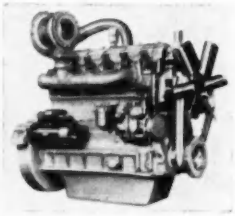
Model WAKDS

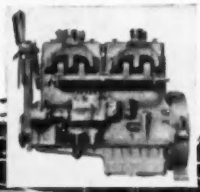
MODEL	Fuel	Features *	Bore and Stroke	Displ. Cu. In.	Max. H.P.
180-DLC	Diesel	4-A	3½x3¾	144	45 @ 2400
185-DLC	Diesel	6-A	3½x3¾	216	60 @ 2400
190-DLCA	Diesel	6-AC	3¾x4	265	85 @ 2800
195-DLCA	Diesel	6-AC	4 x4	302	98 @ 2800
135-DKB	Diesel	6-ACV	4¼x5	426	147 @ 2800
135-DKBS	Diesel	6-ACTV	4¼x5	426	185 @ 2800
148-DKB	Diesel	6-ACV	5¼x6	779	200 @ 2100
148-DKBS	Diesel	6-ACTV	5¼x6	779	280 @ 2100
WAKD	Diesel	6-ACV	6¼x6½	1197	258 @ 1800
WAKDS	Diesel	6-ACTV	6¼x6½	1197	352 @ 1800
NKD	Diesel	6-AV	7 x8¼	1905	297 @ 1200
NKDS	Diesel	6-ACTV	7 x8¼	1905	390 @ 1200
LRD	Diesel	6-A	8½x8½	2894	415 @ 1200
LRDS	Diesel	6-AT	8½x8½	2894	570 @ 1200
ICK	Gasol., Gas	4-IR	2½x3⅛	61	18 @ 3200
FC	Gasol., Gas	4-IR	3¼x4	133	34 @ 2800
180-GL	Gasol., Gas	4-A	3½x3¾	144	45 @ 2400
XAH	Gasol., Gas	4-IR	3⅝x4½	186	47 @ 2200
185-GL	Gasol., Gas	6-A	3½x3¾	216	67 @ 2400
190-GL	Gasol., Gas	6-IR	3¾x4	265	77 @ 2400
195-GL	Gasol., Gas	6-IR	4 x4	302	85 @ 2400
195-GK	Gasol., Gas	6-IR	4⅛x4	320	103 @ 2400
195-GKA	Gasoline	6-ACV	4⅛x4	320	125 @ 3200
BZ	Gasol., Gas	6-A	4 x4¼	320	105 @ 3200
MZA	Gasol., Gas	6-A	4¼x4¾	404	130 @ 3000
135-GKB	Gasoline	6-ACV	4¼x5	426	148 @ 3000
135-GZB	Gasoline	6-ACV	4⅜x5	451	152 @ 3000
140-GK	Gasol., Gas	6-A	4½x5½	525	168 @ 2500
140-GKB	Gasol., Gas	6-ACV	4½x5½	525	178 @ 2800
140-GZB	Gasol., Gas	6-ACV	4⅝x5½	554	187 @ 2800
145-GK	Gasol., Gas	6-A	5¼x6	779	240 @ 2400
145-GKB	Gasol., Gas	6-ACV	5¼x6	779	240 @ 2400
145-GZB	Gasol., Gas	6-ACV	5⅜x6	817	250 @ 2400
WAKB	Gasol., Gas	6-ACV	6¼x6½	1197	280 @ 1800
NKR	Gas	6-IR	7 x8¼	1905	325 @ 1200 (ACV)
LRO	Gas	6-IR	8½x8½	2894	432 @ 1100 (V)
LRZ	Gas	6-IR	9⅜x8½	3520	515 @ 1200 (ACV)

*FEATURES: 4, 6-No. cyl.; A-Alum. Pistons; C-Counterbalanced; Ir-C.I. Pistons; M-Max. Cont. Speed, Counterbalanced; T-Turbo; V-Vibr. Dampner.



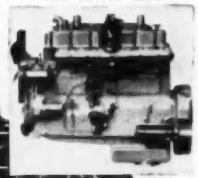
Model 135-DKBS





Model WAKD

Model 145-GKB



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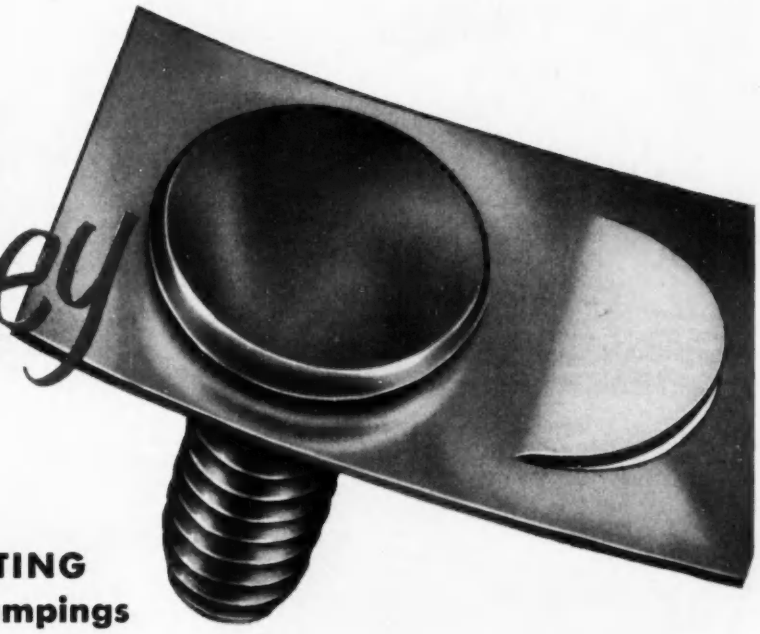
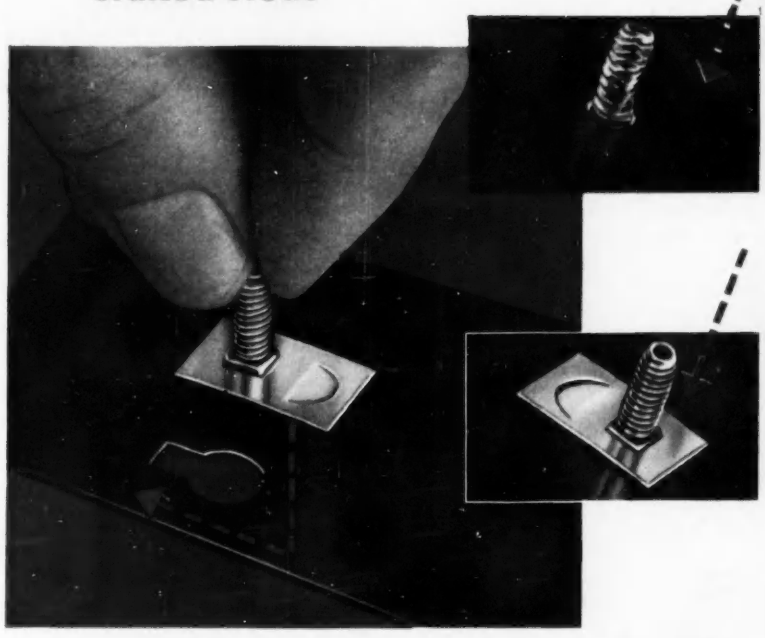
NEW Quickey FASTENER



- **FACILITATES NESTING of sheet metal stampings**
- **ELIMINATES DAMAGE due to welded or staked studs**



Not this

Welded or staked studs are easily damaged in transit from one department to the next or during processing, painting, polishing, etc. The bolts themselves can cause serious damage, denting, scratching or chipping painted or polished surfaces.

But this

QUICKEY SNAPS IN just before final assembly . . . allows finished parts to be nested for economical transportation *without* protruding studs of any kind. Installed at the last moment, every Quickey is perfect. If damaged during later assembly operations, any Quickey can be removed and replaced easily and quickly, even in blind assemblies.

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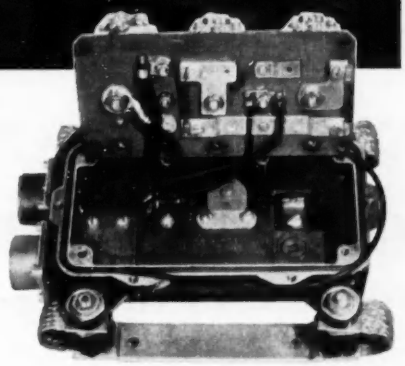
MAKERS OF DOT FASTENERS

Like thousands of other fasteners and allied devices, designed and manufactured by United-Carr, Quickey helps speed assembly and cut costs. Available in a complete range of sizes and in volume quantities; further details on request.

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

Martin B-61 Matador pilotless bomber taking off. Made by the Glenn L. Martin Company, Baltimore, Md.

Jeep almost completely submerged. Can be operated in this position at about 9 miles per hour. Made by Willys-Overland Motors, Inc., Toledo, Ohio, for the Armed Forces.



Generator regulator for the 24-volt system of the submersible Jeep. This is completely waterproof and highly resistant to corrosion and fungi. Produced by The Electric Auto-Lite Company, Toledo, Ohio.

Illustrated are two of the many types of capacitors and filters made by Aerovox Corporation, New Bedford, Mass.; an important capacitor supplier to both Electric Auto-Lite and Glenn L. Martin. The unit above is the filter capacitor used in the generator regulator of the submersible jeep while the unit at the right is used in the pilotless bomber.

In the Air— On Land— Under Water—

WHERE REQUIREMENTS ARE SEVERE, CALL REVERE

The dramatic pictures on this page show two important special applications of Aerovox capacitors. One is the Martin B-61 Matador pilotless bomber. It contains an Aerovox capacitor, which has to withstand the terrific acceleration and speed of the craft. The other is the submersible Jeep. Its 24-volt electrical system is completely waterproofed, and includes Aerovox filters and capacitors for suppression of radio interference. Revere not only supplied copper and brass strip for the capacitor cases, but collaborated closely in setting up specifications, and in addition worked on a welding problem. In regard to the latter, an Aerovox Project Engineer wrote: "We have had much better welds." . . . Revere is always glad to collaborate on problems concerning copper and its alloys, aluminum alloys, and electric welded steel tube. Call the nearest Revere Sales Office.

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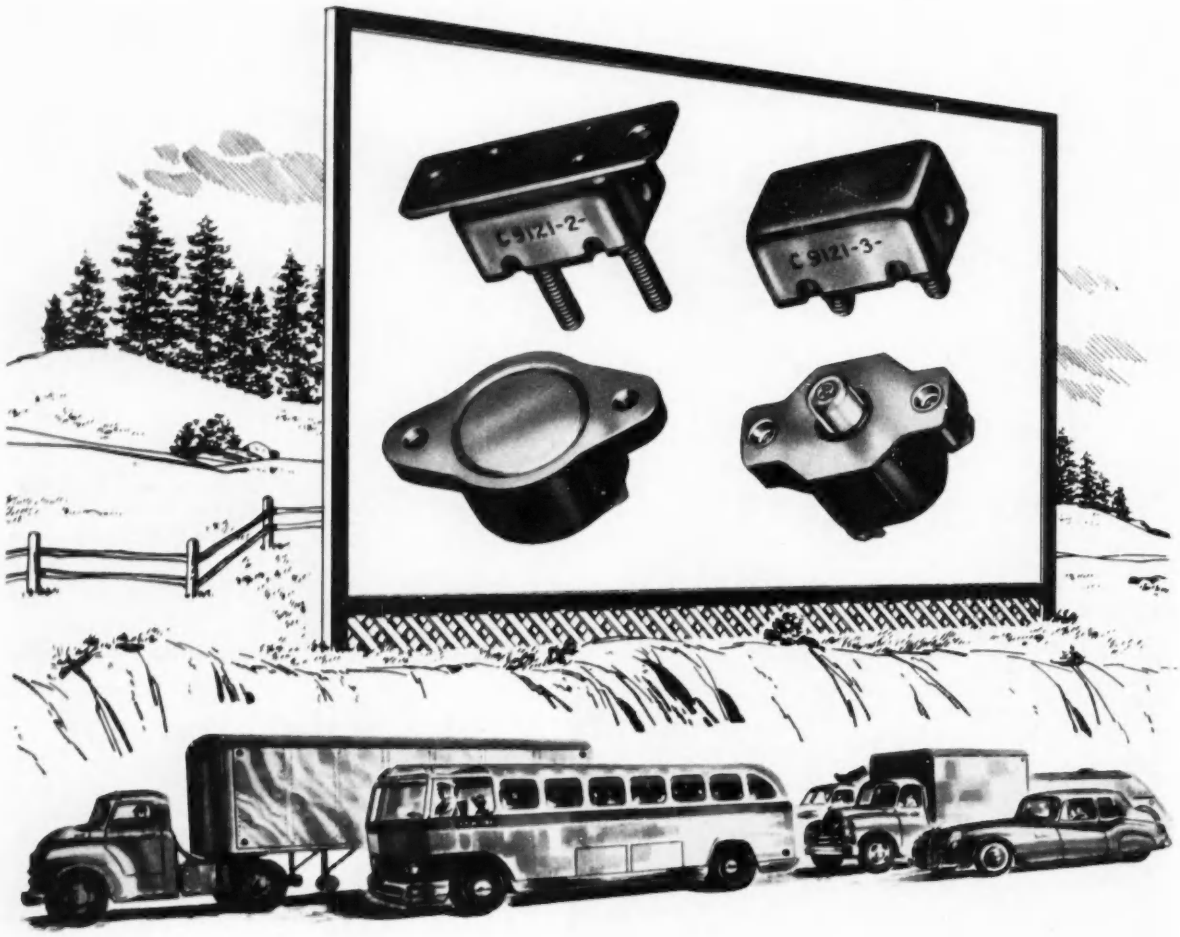

On Highways and Byways

KLIXON CIRCUIT BREAKERS

keep equipment rolling with positive circuit protection

Designers of electrical circuits can eliminate the disadvantages of fuse protected circuits and fuse burnouts by incorporating Klixon permanent Circuit Breakers into all cars, buses, trucks, farm equipment and other mobile units.

Because Klixon Breakers are permanent protective devices, they need no replacements for the full operating life of the car.

Klixon Circuit Breakers give you the following advantages:

1. They carry full rated current as long as the circuit remains normal.
2. They open the circuit the second a harmful overload or short occurs.
3. They eliminate fuses and the hunting for fuses which may be in inaccessible locations.
4. Completely sealed types available for protection against dirt, moisture, grease, oil, etc.

Investigate Klixon Circuit Breakers for all circuits in all types of mobile equipment. Sample and complete information will be sent on request. Write:

KLIXON

TRADE MARK REG. U. S. PAT. OFF.

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Division of Metals & Controls Corporation
1609 FOREST ST., ATTLEBORO, MASS.

For the Sake of Argument

A Fine and Wavy Line . . .

by Norman G. Shidle

The successful supervisor seems to draw a fine line between interfering too much with a subordinate's work and leaving him too much alone. He seems to know that the line has to be wavy; that Art welcomes as a show of interest by the boss exactly the same "advice" that Ed takes as interference.

So, he tailors his handling for those who are eager and those who are stolid; for those who are happy and those who are sad. He moves by a sort of sixth sense in the twilight zone of paying too much attention to details and paying no attention to them.

"I have found," a supervisor said the other day, "that I must keep close enough to the details to permit me to appreciate and appraise the individual's performance. The minute I show ignorance of the processes by which he got a good result, my praise sounds hollow—even though it *is* perfectly sincere.

"Most folks, I've found, get the biggest lift from praise which understands how smart they've been; how conscientious they have been; how clever they were to overcome difficulties . . . praise about *them* from a greater expert than they.

"To come up with this kind of praise, I have to have participated to some extent in the operation. The least stimulation seems to come from praise which expresses chiefly my own gratification and pleasure in the result. Most people like to be appreciated as artists or skilled workers."

This supervisor probably is right on the average. But it's a good guess that he, too, does his "tailoring" along a wavy line.

Wonder chemical

CHANGES METAL SURFACES, MAKES PAINTED PRODUCTS *look better longer*

NOT ALL "wonder chemicals" are new! Here's one that for more than a score of years has been doing a job that manufacturers at first said couldn't be done.

In as little as sixty seconds, Bonderite changes the surface of metal parts to a *nonmetallic* layer of unusual properties. Bonderite is used on automobile bodies, refrigerator cabinets, transformers, hardware, and metal furniture, to name a few items out of thousands.

This nonmetallic coating does several amazing things. Because it has an affinity for organic coatings and is integral with the metal, it takes and holds paint securely, preventing chipping and peeling. It acts to keep moisture from reaching the metal, thus controlling rust and corrosion. And should the paint film be damaged by accidental scratch or dent, Bonderite prevents the spread of finish failure.

All of these benefits combine to mean lasting fine appearance for those thousands of products whose manufacturers use Bonderite before painting.

Unlike many "wonder chemicals," Bonderite requires no special handling. It produces excellent results in large and small installations, in spray and immersion applications, and on steel, aluminum, zinc, or cadmium and their alloys.

The cost of Bonderite is small—a fraction of a cent per square foot of area treated—and the benefits are great.

Your inquiry will get prompt, expert, helpful attention.

*Bonderite, Bonderlube, Parco, Parco Lubrite — Reg. U.S. Pat. Off.

Parker

RUST PROOF COMPANY

2181 East Milwaukee, Detroit 11, Michigan

BONDERITE — corrosion resistant paint base

BONDERITE and BONDERLUBE — aids in cold forming of metals

PARCO COMPOUND — rust resistant

PARCO LUBRITE — wear resistant for friction surfaces

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Norman G. Shidle
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Joseph Gilbert
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Contents—November 1953

■

Bendix Low Pedal Power Brake

one of the most popular new car features in years

Specified by More Car Manufacturers Than Any Other Make

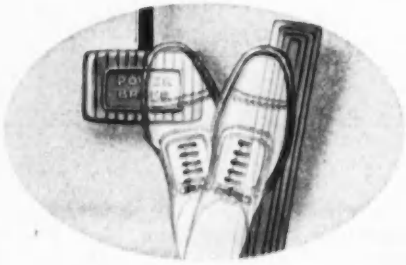
Since the earliest days of the industry, car manufacturers have entered each model year with a host of new improvements that represent added value for the motoring public.

While all of these advancements have contributed to greater motoring enjoyment, the "new car features" that have basically altered previous motor car standards of performance are relatively few in number. For example, four-wheel brakes, a Bendix development, brought new safety to the highways; automatic transmissions materially increased driving ease; and today another great new feature, Bendix* Low Pedal Power Brake, is recognized as a revolutionary advancement in motor car control.

It is the only low pedal power brake that has met the test of millions of miles. In fact, Bendix Low Pedal Power Brake is specified by more manufacturers than any other make. It is the product of Bendix—world's largest producer of power brakes and leader in braking developments since the earliest days of the industry.

To make your line more popular it pays to equip with the performance proven Bendix Low Pedal Power Brake. *REG. U.S. PAT. OFF.

NOW *Stopping* IS AS EASY AS *accelerating*



It is no longer necessary to lift the foot and exert leg power pressure to bring your car to a stop. With the Bendix Low Pedal Power Brake on about the same level as the accelerator, an easy ankle movement, much like working the accelerator, is all the physical effort required for braking. And by merely pivoting the foot on the heel, shifts from "go" to "stop" controls are made in far less time.

Result! **MORE DRIVING COMFORT, LESS FATIGUE AND GREATER SAFETY**

Bendix Products Division

BENDIX PRODUCTS DIVISION SOUTH BEND

Bendix
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Consistency rather than Formula pays off in vehicle replacement

Fleet men stand to gain more from holding to a given retirement program than from worrying about picking the ideal replacement period.

Howard Willett Jr., Executive Vice-President, The Willett Co.

Based on paper "How Long Should You Run a Truck to Get the Lowest Combined Depreciation and Maintenance Cost?" presented at SAE International West Coast Meeting, Vancouver, August 19, 1953.

AFTER a vehicle is one or two years old it doesn't make much difference when we replace it from an operations cost viewpoint. That's what an analysis of a number of trucks in our fleet tells us.

Your cost studies alone won't tell you when to replace your vehicles. Your treasurer will have a lot to say about this since he knows the value of capital to your firm. But by setting up a replacement schedule and sticking to it, a company will go a long way toward permitting its maintence superintendent do a better job.

Fleet operators know they can run a truck as long as they have to. In fact, sometimes the only original part on the truck is its company number. We have run trucks long past their economic usefulness . . . sometimes in error, sometimes on purpose. Sometimes we are forced to make costly repairs when we know we shouldn't.

But if we knew in advance when a truck is scheduled to go out of service, we could save lots of time, money, and worry on its maintenance. And if we knew the best time on the average to sell or trade the vehicle, we could make up a replacement schedule a year in advance. Then we could synchronize our buying, selling, and maintenance of the fleet. It's this synchronization which will produce the most economy.

In finding out how long we should run a truck to get the lowest combination of depreciation and maintenance cost, we had to determine two things:

1. The various items that make up these costs.
2. Which of these items are affected by time, and which are not.

Breaking down these cost items, we have assumed that the following costs do not vary with truck age (although we recognize that there is some room for argument here):

a. License
b. Storage
c. Insurance
d. Driver's Wages
e. Tire Depreciation

The items that do vary with the age of the truck —how long we are going to run it—are as follows:

1. Depreciation—The longer we run a truck, the less its depreciation per year, and conversely. In our studies we have taken actual depreciation as determined by market values of trucks rather than book value.

2. Maintenance Labor and Parts—These cost items increase as the truck grows older. A five-year old truck costs more to maintain than a one-year old truck. In our

analysis we have taken mileage figures and converted them to yearly costs.

3. Gasoline and Oil—These figures are controversial. A five-year old truck maintained in top-notch condition could conceivably consume the same amount of gasoline and oil per mile as a one-year old vehicle. But this is not always the case.

4. Garage Servicing, Hiking, Washing—It certainly doesn't cost more to wash an old truck than a new one. But we can't separate these costs in our books. So they are included in the varying charges. However, our results are not affected by loading a constant on both sides.

5. Garage Overhead — We consider as garage overhead such items as supervision of mechanics, stockroom operating costs, rags, etc. This is added proportionately to the labor and parts a vehicle consumes. A truck using lots of parts and labor uses up more supervisory time and stockroom cost than a vehicle that seldom comes into this shop. So the older a truck gets, the more garage overhead dollars it gobbles up.

Now let's look at the tabulations below

because they show us what happens to costs

if we run trucks any period from one to ten years.

1—Here is how the market depreciates various type vehicles each year. The percentages are the ratio of average cash value to factory price.

After . . .	Tractor		Truck	
	Heavy	Medium	1½-Ton	½-Ton Panel
1 year	58.5%	60%	61%	60%
2 years	51%	51%	53%	52%
3 years	46%	45%	46%	46%
4 years	38%	40%	40%	42%
5 years	33%	34%	35%	34%
6 years	27%	27%	32%	33%
7 years	24%	25%	28%	29%
8 years	23%	25%	27%	—
9 years	21%	24%	22%	—
10 years	—	—	—	—
11 years	20%	23%	21%	21%
12 years	16%	21%	18%	20%

Note how little difference there really is between widely varying sizes of vehicles.

2—This is the way we determined the actual market depreciation rate.

After . . .	From Previous Tabulation		Arbitrary Selection of Market Valuation	Actual Market Depreciation
	Lowest Depreciation	Highest Depreciation		
1 year	58.5%	61%	60%	40%
2 years	51%	53%	52%	8%
3 years	45%	48%	47%	5%
4 years	38%	42%	40%	7%
5 years	33%	35%	34%	6%
6 years	27%	33%	30%	4%
7 years	24%	29%	26%	4%
8 years	23%	27%	24%	2%
9 years	21%	24%	22%	2%
10 years	—	—	20%	2%
11 years	20%	23%	18%	2%
12 years	16%	21%	15%	3%

3—And this is the actual depreciation expense incurred each year for the four type vehicles analyzed.

Original Price	½-Ton Panel Truck $1600	1½-Ton Light-Duty Chassis and Cab $1600	Medium Tractor $2700	Heavy Tractor $6000
After 1st year	$640	$640	$1080	$2400
After 2nd year	128	128	216	480
After 3rd year	80	80	135	300
After 4th year	112	112	189	420
After 5th year	96	96	162	360
After 6th year	64	64	108	240
After 7th year	64	64	108	240
After 8th year	32	32	54	120
After 9th year	32	32	54	120
After 10th year	32	32	54	120

4—And these are the variable (with age) operating costs for the four type vehicles.

Year of Operation	Operation at 10,000 miles per year		Operation at 20,000 miles per year	
	Cost per mile	Cost per year	Cost per mile	Cost per year
		½-Ton Panel Truck		
1	6.5¢	$ 650	5.5¢	$1100
2	8.5¢	850	7.5¢	1500
3	9.5¢	950	8.5¢	1700
4	10.5¢	1050	9.5¢	1900
5	11.5¢	1150	10.5¢	2100
6	12.5¢	1250	11.5¢	2300
		1½-Ton Light-Duty Truck—Chassis and Cab		
1	8¢	$ 800	6¢	$1200
2	10¢	1000	8¢	1600
3	11¢	1100	9¢	1800
4	12¢	1200	10¢	2000
5	13¢	1300	11¢	2200
6	14¢	1400	12¢	2400
		Medium Tractor		
1	11.5¢	$1150	9¢	$1800
2	15¢	1500	11.5¢	2300
3	18¢	1800	13¢	2600
4	21¢	2100	14.5¢	2900
5	24¢	2400	16¢	3200
6	27¢	2700	17.5¢	3500
		Heavy Tractor		
1	14¢	1400	11¢	$2200
2	17.5¢	1750	13.5¢	2700
3	20.5¢	2050	15.5¢	3100
4	23.5¢	2350	16.5¢	3300
5	26.5¢	2650	18.5¢	3700
6	29.5¢	2950	20.0¢	4000

Included here are the following costs: gasoline and oil, maintenance parts and labor, garage servicing, hiking and washing, tire repairs, and garage overhead. Note that the cost per mile for a 20,000 mile per year operation is less than that for 10,000 miles per annum. That's because a truck which spends more time putting miles on the speedometer is more efficient than one that spends the larger part of its work day standing, waiting, stopping, and starting, as in a 10,000 mile per year operation. In both cases, we assumed a full 52-week year operating five days per week, 8 hr per day.

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5—This is how average annual operating costs compared.

For a 10,000 Mile per Year Operation

Years of Operation	½-Ton Panel Truck	1½-Ton Light-Duty Truck	Medium Tractor	Heavy Tractor
1	$1290	$1440	$2230	$3800
2	1134	1284	1973	3015
3	1099	1249	1960	2793
4	1115	1265	2043	2788
5	1141	1291	2146	2832
6	1170	1320	2257	2891
7	1191	1341	2335	2934
8	1202	1352	2388	2951
9	1211	1360	2428	2972
10	1218	1368	2461	2975

For a 20,000 Mile per Year Operation

1	$1740	$1840	$2880	$4600
2	1684	1784	2698	3890
3	1716	1816	2710	3727
4	1790	1890	2805	3725
5	1871	1971	2916	3792
6	1953	2053	3032	3866
7	2042	2112	3114	3920
8	2052	2152	3169	3945
9	2083	2183	3212	3972
10	2108	2208	3246	3980

These costs were computed from the figures in tables 3 and 4. Here is how they were arrived at: The cost at any given year equals the cumulative operating expenses plus the cumulative depreciation expense divided by the number of years the vehicle has been operated. Expressed mathematically, the expression would be:

$$C_n = \frac{D_1 + D_2 + \ldots D_n + E_1 + E_2 + \ldots E_n}{n}$$

where:

C_n = annual operating costs for a given year
D = depreciation expense
E = variable operating expense
n = number of years vehicle has been operated

Since we had no operating expense records for years past the sixth, we continued to use the six-year figure for the subsequent years.

It is interesting to note from the above tabulation that after an initial year of heavy depreciation, cost continues downward for several years and then starts back up again as the weight of increasing maintenance begins to be felt. It's remarkable that there is so little difference between the cost of operating a truck for two years, three years, or ten years.

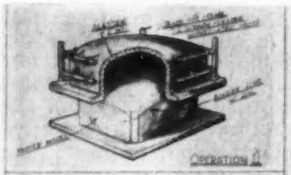
What this evaluation really tells us is this:

What's important is not the dollar values shown. No two companies, even in the same city, would show exactly the same dollar costs. But we do feel that the pattern—the early downward trend in costs and then the upward swing—is universally applicable. And the payoff in applying the pattern is in setting up a regular replacement program with which a maintenance program can be coordinated.

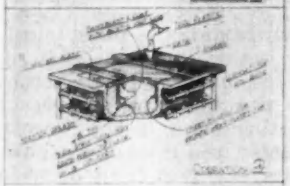
(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

see page 59 . . . for complete editorial report of the SAE National Aeronautic Meeting.

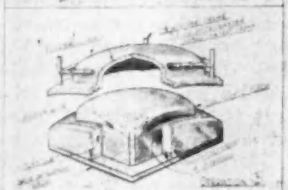
see page 70 . . . for complete editorial report of the SAE National Tractor Meeting.



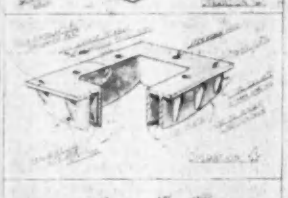
1. Making the Splash Casting



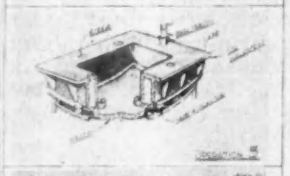
2. Casting the Punch



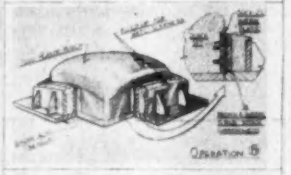
3. Developing the Binder Ring Model



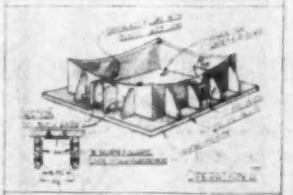
4. Making a Steel Weldment for Binder Ring



5. Joining Binder Ring to Weldment

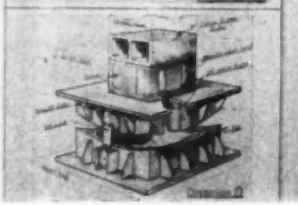


6. Preparing Punch to Make Cavity



7. Preparing the Die Tub

8. Completing the Die Tub



9. Proving the Tool

How to Make Plastic Draw Dies in 9 Steps

G. C. Adams, Rezolin, Inc.

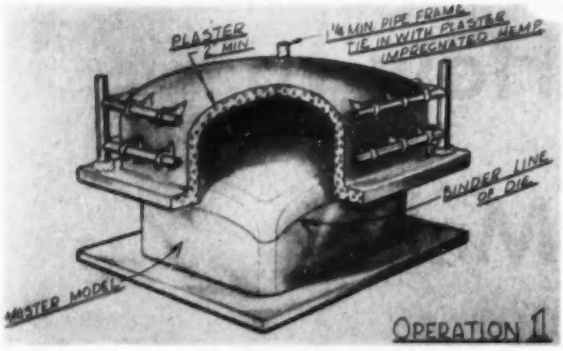
Excerpts from paper "The Use of Plastic for Draw Dies and Related Automobile Body Tooling" presented at SAE Detroit Section, Dec. 8, 1952.

IT still startles people to hear that tooling of plastic material can be used to form passenger car body panels by conventional sheet metal forming processes.

The technique is well past the laboratory stage. Plastic dies have been run in Detroit that have produced more than 20,000 stampings at the rate of 320 per hour. The tools were not worn out, although they did require some maintenance.

The plastic die whose construction is described here is of the short-run variety, designed for prototype, development work, or custom body building. Practically the same technique can be used for building long-run dies. Only difference between the two is that the die for extended runs is made with metal wear plates to prevent the tool plastic from eroding during the drawing process.

Step 1 – Making the Splash Casting



First take a conventional die model setup, in the die position required to develop the binder line properly, on a flat base or surface plate. The surface of the model is faired with plaster of paris until we have developed a satisfactory draw punch configuration.

The model is now treated with a parting agent that will enable us to take from it a plaster of paris splash casting. We have found by experience that the best material to use for plaster castings is U. S. Gypsum Hydrocal B-11, or an equivalent. This splash casting will eventually become a draw die punch mold. It is approximately 2 in. thick and is supported by a steel pipe weldment arranged so that the pipe structure supports the plaster mold, preventing distortion before and after subjecting to oven cure of approximately 180 F.

Therefore, it is important that the plaster and hemp ties which bind the mold and its supporting frame together, be arranged so that they can slip or bend on the pipe structure without distorting the mold when this assembly expands due to the applied heat.

Note the flange which surrounds the mold and is parallel to the plate upon which the model was set up. This flange is very important since it establishes the die position of the mold and enables us to retain coordination further along in the process.

After the mold is completed and inspection shows that it is dimensionally correct, it is force dried in an oven to remove excess moisture as far as practical. This is very important because a wet mold is difficult to finish properly. A damp mold always makes an inferior tool plastic casting. After the mold is thoroughly dried, it is spray-painted using first a sealer coat. Wood sanding sealer is satisfactory for this purpose. Sufficient sealer should be applied to develop a slight gloss on the surface of the mold.

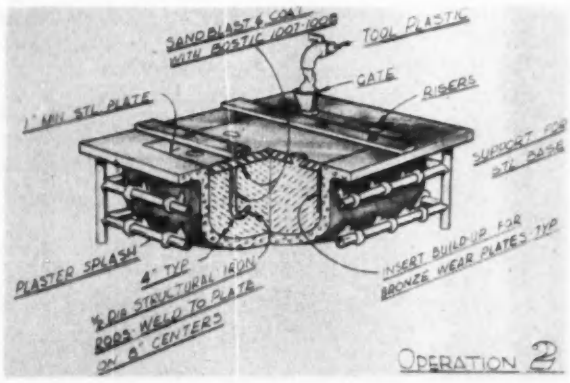
The next application is a coat of soft primer surfacer, such as used in painting automobile bodies. It is recommended that this surfacer be of a soft type that can be easily sanded down to remove any minor contour imperfections, and develop a smooth, glass-like surface. Finally, the surface of the mold is painted with an acid resistant lacquer. Light coats should be used throughout the finishing process, avoiding excessive shrinkage of any paint film. If a heavy paint film is applied, it will sometimes shrink away from the plaster casting, destroying the configuration dimensionally.

Step 2 – Casting the Punch

First, we make a steel base plate. The size and shape of this steel base may be taken directly from the punch mold. On one side of the plate, weld anchor hooks made of structural reinforcing iron. The size and shape of these hooks depend on the configuration of the punch.

After all welding is completed, the assembly is normalized and sand-blasted. It is then machined on the side opposite the hooks to produce a flat surface. The unmachined surface, that is, the anchor hook side of the weldment, is coated with Bostik No. 1007 and 1008. This is a two-stage material, the first number being a primer and the second an adhesive. The Bostik material serves a dual purpose. It prevents reaction between the metal and the tool plastic material; but more important, it establishes a bond between the two materials.

Wooden blocks, of the size and shape required to make a pocket to receive the bronze wear plates, are placed in the proper position in the mold. The base plate is assembled with the mold, care being taken to align the machined surface of the plate with the flanges of the mold. That locates the base of the punch in die position. The opening between the



edges of the base plate and the mold are sealed with masking tape and plaster of paris.

The casting is made of tool plastic. In the case of Rezolin materials, this consists of four parts resin and one part accelerator paste. This mixture, properly blended, is poured in through the gate of the mold until the mold is filled and all trapped air has been evacuated through the risers.

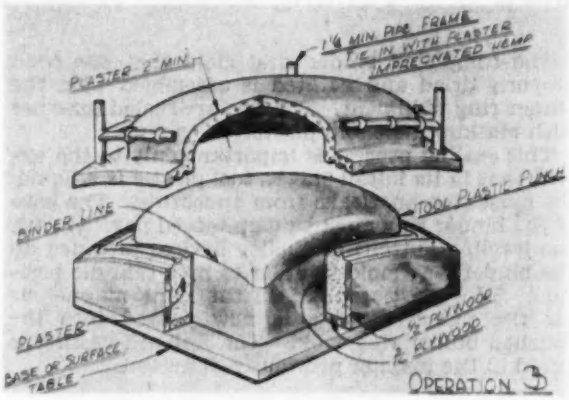
The casting is then allowed to stand at room temperature for 24 hr. It is then subjected to heat curing at 180 F from 24 to 36 hr in a recirculated air oven. The exact time will depend upon the cross-section of the tool plastic involved.

There is no substitute for the adequate heat curing of a phenolic casting. All chemical compounds known to us that are self-curing, either do not sufficiently stabilize the material to make its use practical in the tooling field, or do not create the physical properties necessary for structural requirements. After the tool plastic casting has been removed from the oven and allowed to cool, it is separated from its plaster mold and cleaned.

Step 3 – Developing the Binder Ring Model

The finished tool plastic punch has been transferred to a surface plate and set up far enough from the edges of the plate to permit the development of the binder ring model around the punch. This model may be made from a combination of plaster and plywood. You will note that a 3/16-in. sheet of plywood has been inserted around the periphery of the punch from the surface table to the binder line. This 3/16-in. sheet of plywood will provide the required clearance between the binder ring and punch in most cases.

After the binder ring model has been completed, a plaster splash casting is made of the working face of the binder ring and the punch. This casting is made and finished in the same manner that was used to develop the tool plastic punch mold. Leveling buttons or some similar device must be incorporated in the binder ring mold so that we may maintain die position of the tool with reference to the surface plate.

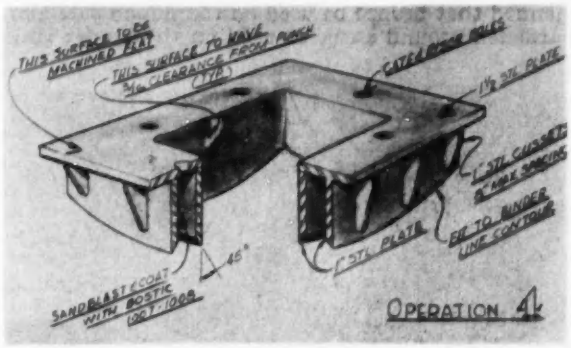


Step 4 – Making a Steel Weldment for Binder Ring

In this step we develop a steel weldment which will contain the binder ring. The illustration at right shows a typical weldment of this type. It is composed of boiler plate of sufficient thickness and reinforced with gussets to withstand the pressures applied upon a binder ring.

After all welding is completed, the weldment must be normalized and sandblasted. The base is machined flat and holes drilled in the base of the weldment for the gate and risers. All surfaces of the weldment that will come in contact with tool plastic are coated with the Bostik materials previously referred to.

The chamfered edges of the binder ring adjacent to the working face are snag-ground to approximately the same contour as the binder ring model. Extreme precision is not required in this case since the tool plastic casting to be made in the binder ring weldment provides the necessary accuracy.



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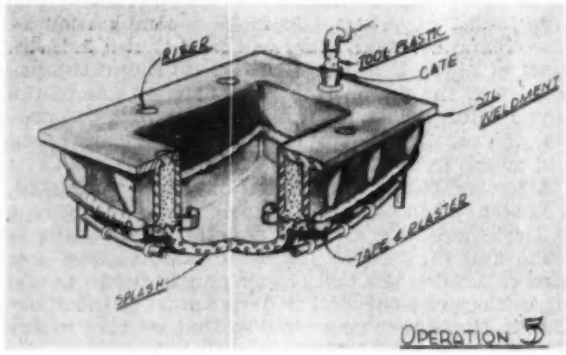
To Make Plastic Dies You Will Need These Plant Facilities. . .

- Plaster pattern shop equipped with a series of surface plates, together with their usual accessories upon which models are built.
- Conventional template shop.
- Welding shop capable of fabricating structural steel and plate.
- Machine shop.
- Paint shop similar to that for repainting and repair of car bodies.
- Plastic shop with a plastic mixer and some dollies to carry the molds and a recirculated hot-air oven.
- Tool crib stocked with the usual equipment.

Step 5 – Joining Binder Ring to Weldment

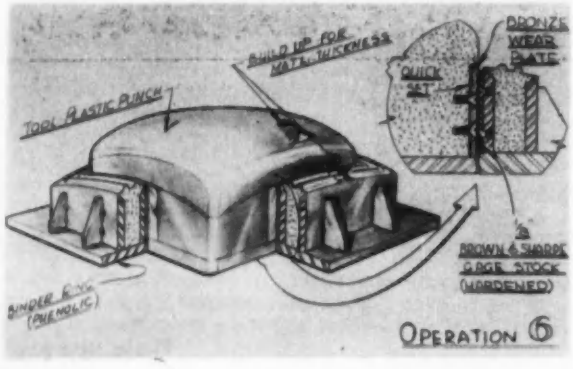
The completed binder ring mold that has been properly dried and painted is assembled with the binder ring weldment. The two are sealed together with masking tape and plaster.

This sealing process is important only to the extent that in its initial stages, tool plastic is a liquid. We must stop any leaks from appearing. The base of the binder ring must be maintained parallel with the leveling buttons or similar devices provided on the binder ring mold in order to maintain die position. Tool plastic, mixed in the same manner as for the punch casting, is now poured into the finished binder ring mold. The finished casting is cured in the manner previously discussed.



Step 6 – Preparing Punch to Make Cavity

The binder ring and punch are assembled in the closed die position. Note in the drawing below that the wear plates on both the binder ring and punch have been fitted and placed in position. It is recommended that bronze be used on the punch side and hardened ground stock be used on the binder ring side for these bearings. Quickset tool plastic may be used as a potting mixture to quickly and economically locate the bronze wear plates on the punch. Caution should be exercised in assembling the punch and binder ring into closed die position since we intend to make a direct duplication of the working face of both components to create the die cavity.



The binder ring and punch assembly is now built up to add material thickness. This may be accomplished by one of two methods:

1. Conventional pattern maker's sheet wax of the proper thickness. 2. The spray paint build-up method.

Our experience indicates that the spray paint build-up method is far superior. The lines formed by the adjoining sheets of wax are completely avoided and a much smoother surface thereby developed.

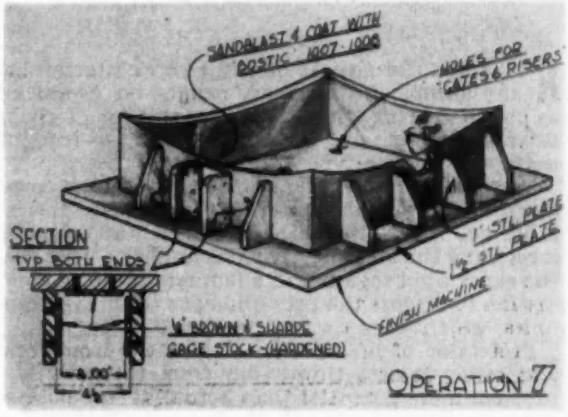
This spray paint process is relatively simple. It consists mainly of the spraying of a coat of vinyl type lacquer on the surface to be built up, and subsequently spraying the required number of coats of surfacer to build up a paint film to the desired thick-

ness. Small bits of metal of the same thickness as the stock to be run in the die may be cemented in various locations to serve as gauges during the spray paint build-up. When the build-up is completed, these metal gauges are removed and the spot filled in with the surfacer used on the balance of the tool.

This technique may sound a bit complicated, but really isn't. The average automobile body spray painter can master it within a few hours. After the paint build-up has been made to the required thickness, the surface is then sprayed with an acid resistant lacquer.

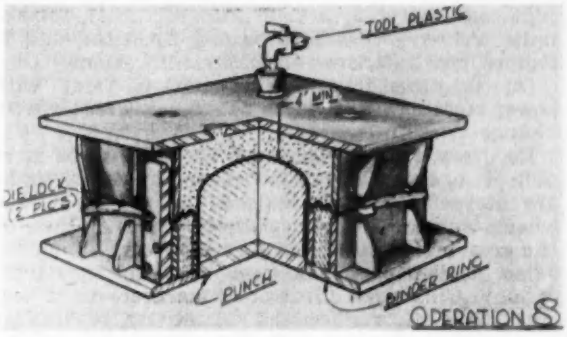
Step 7 – Preparing the Die Tub

At this stage, we develop a steel plate weldment of the size and shape required by the particular configuration developed from the binder ring and punch assembly. This weldment, or die tub, is strong enough to withstand the force that will be exerted on it with a minimum deflection. Provisions are made for the installation of die locks that may be specified by the tool designer. All surfaces of the die tub that come in contact with plastic are coated with Bostik materials. The beveled knife edge that will come in contact with the binder ring is roughly snag-ground to the proper contour.



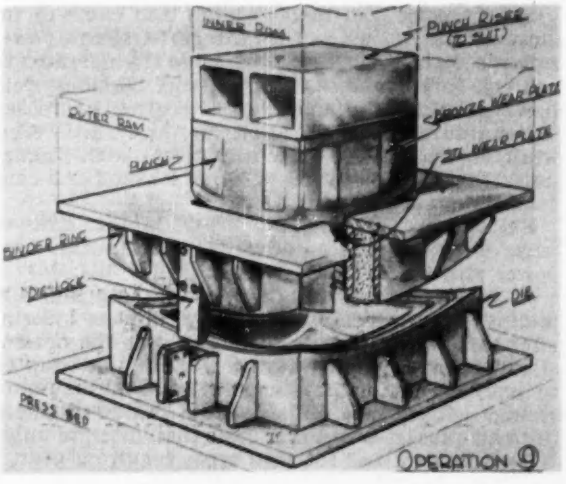
Step 8 – Completing the Die Tub

In this operation, we make the last casting involved in the manufacture of the die. The die tub weldment, binder ring, and punch have all been assembled in proper relation to each other in closed die position. The die tub weldment has been properly aligned and the die locks fixed in place with screws and dowels. The joint between the binder ring and the die tub weldment is sealed with tape and plaster. The die casting is made through the gate. The same heat curing method previously used is again followed.



Step 9 – Proving the Tool

In the drawing at right we see the completed die we have been discussing ready for tool proving. If all the previous operations have been performed in a workmanlike manner, the tool proving time should be comparatively short. It has been our experience that in most cases, from 8 to 16 hr press time is all that is required to prove a plastic draw die of this type.



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Linkage-Type Gears Vie for

NOT since the advent of the electric starter has any automobile accessory caught on so quickly as power steering. In the race for this job of giving drivers a steering assist are two entries—integral units and linkage-type units.

Last year at an Annual Meeting panel on power steering, discussion centered around the first of these two types—integral units, which apply power directly to the steering-gear mechanism. This year the experts got together at a Summer Meeting panel session to discuss the pros and cons of linkage-type units, which work on the steering linkage.

Protection of linkage-type equipment from rocks and other objects thrown up from the road is a problem more potential than actual, it was pointed out. In most cases, front suspension parts and members afford the necessary shielding.

Installation problems seem to be of little concern, said the experts, since a linkage system requires little if any more space than the steering components replaced. As compared to integral units, linkage units were reported to be easier to install and to require less extensive chassis modifications.

On the other hand, the problem of "feel" with power steering was said to be slightly greater with linkage-type units.

Recovery, too, was generally conceded to be more difficult to obtain. This is because linkage systems are interposed between the gear box and the steered wheels and steering-wheel inertia is magnified by the gear box ratio. (For good recovery, higher reverse efficiencies of the gear box itself are indicated.) This same effect does, however, noted several panelists, reduce the sensitivity of linkage systems to extraneous disturbances such as road irregularities and self steering from body roll, jounce, or brake applications.

Safety aspects of linkage units also came in for close scrutiny. Just as with integral systems, power failures with linkage systems leave the operator in control, it was stated. Some panel members felt, however, that the underbody location increased vulnerability to stones, dirt, ice, and salt. Also, while efficiencies are generally better with linkage units, there are more joints for oil leakage and contamination, it was pointed out.

Better accessibility and fewer highly stressed parts were outlined as advantages of linkage-type power steering.

As for cost of installation, manufacturing, and tooling, some specialists felt that linkage systems offer some advantages. Particularly at the present stage of development where power must be adapted to existing manual systems with a minimum of change. Right now, linkage units can be produced in small quantities at lower costs than integral units.

Both linkage and integral types require a gear, a control valve, and a power cylinder. Whether these components are combined in a single unit, as in integral gears, or remain separate units would seem to depend on two things:

1. What tooling costs are justified by the production quality involved.
2. What modifications chassis engineers are prepared to make to adapt the gear to a vehicle.

However, since power steering is rapidly leaving the accessory class, reduction in cost and design simplification can be expected to occur with both integral and linkage types. And, as the popularity of power steering continues to increase, designs will be modified to integrate the power system to a logical whole, it was felt.

The next year or two, the experts thought, should tell whether it will be a lighter, simplified, integral gear or a linkage-type system. Meanwhile, linkage units are primarily used today on the lighter cars with shorter wheelbases and smaller tires. Here, power steering is more a delightful convenience and luxury than a stark necessity.

Question: What design features are provided to protect linkage-type equipment from abnormal weather and road conditions?

Answer: Major protection is supplied by the automobile in general and by the various parts and members of the front-suspension assembly in particular. Valves and cylinders are so located that any projection from the road will be unable to reach them unless it also reaches other vital parts of the automobile. These components are protected from rocks and other projectiles by front-suspension members and the steering linkage itself. Valves also are protected by their rugged cast or forged exterior housing. As for hoses and pumps, they are so installed as to receive protection from the vehicle structure. Protection against ice, mud, and other material which tends to adhere to, or coat, piston rods has been achieved with boots, wipers, and so forth.

Question: What are some of the installation problems of linkage-type systems?

Answer: Installation problems with linkage-type gears are in general the same as those for any equipment where space is limtied. The major problem seems to be in obtaining oil-pan clearance.

Question: How do installation, manufacturing, and tooling costs of linkage and integral gears compare?

Answer: Tooling costs are about 30% lower for the linkage or booster type. Reductions of 10 to 15%

Slice of Power-Steering Plum

W. A. McConnell, Ford Motor Co.

Based on secretary's report of Panel on Linkage-Type Power Steering held under the auspices of the SAE Passenger-Car Activity at the SAE Summer Meeting, Atlantic City, June 8, 1953. Panel Leader was P. H. Pretz, of Ford.

What Power-Steering Terms Mean

Steering effort describes how hard the driver must turn or pull on the steering wheel to steer the car. It is usually expressed in terms of pounds pull at the rim of the steering wheel.

Steering ratio tells how far the steering wheel must be turned to obtain a certain amount of turning of the steering knuckles.

Recovery is the tendency of the steering system to return to a "straight ahead" or "centered" position when the car is moving on a straight, level road and no force is being exerted on the steering wheel.

Directional stability is the characteristic a car and steering system can be said to have if a car continues to move in any direction the driver wishes it to, with a minimum tendency to wander or to be affected by ruts.

Feel of the road is the ability of the car and the steering system to provide the driver with the feel of the road surface and the knowledge that the car is changing course (whether the driver's eyes are on the road or not—provided his hands are on the wheel).

Response is the ability of the car and its steering system to follow the desires of the driver as he expresses them by movement of the steering wheel. It is the property which facilitates making all maneuvers which require quick and accurate steering.

Linkage Gears A Stopgap, Says Power-Steering Specialist

TO Consulting Engineer F. W. Davis, linkage-type gears are primarily a stopgap on large production jobs. But they're very useful for small production and difficult installations where the chassis engineer can't or won't provide space for the integral unit, he feels.

Davis lists these as definite advantages of linkage gears—easy attachment without serious interference, noise isolation from the chassis attachment, remote control, possibility of installation on old model cars.

In the realm of questionable advantages, he checks off these points—weight and cost savings, and the possibility of using a single stock gear for all models where power assistance is optional. The latter advantage is doubtful, Davis notes, where different ratios are used with and without power assistance.

As for disadvantages of linkage gears, as compared to integral ones, Davis cites—elaborate hose connection with some movement, exposure to accidental injury and corrosion, added unsprung weight, oil leakage around the piston rod, and contamination of the working fluid.

With power steering generally accepted, Davis looks for smaller and lighter integral units and proper tooling for quantity production of these units. Noise reduction may be achieved by further pump development and better workmanship. And installation difficulties, he maintains, can be dissipated with proper planning by chassis and steering-gear engineers.

may be possible with the integral type, however. Installation cost at the factory is about the same for both units. The linkage type would appear to be best for low production cars—as optional equipment or for after-sale installation where production volumes do not justify integral-gear tooling costs.

Question: What are some of the safety features of linkage-type steering gears under normal conditions and in the event of pump failure, loss of pressure, and so forth?

Answer: Safety considerations are much the same as for integral power steering. A few points do, however, apply more specifically to linkage units.

The actuator is located closer to the steered wheels in linkage systems. Thus, being more directly responsive to reaction forces, it may be regarded as a strut providing greater resistance to self steering from body roll, jounce, or brake applications. (Some designers envisage the steering actuator applying force directly to the knuckle arm. In some cases, there may be cross-connected dual actuators so that tie rods will not be loaded by the power-steering forces.)

Compared to integral units, working pressures of linkage gears can be less, although the volume of oil pumped will have to be more for the same power. Efficiency is apt to be higher than the efficiency of the leverage system in integral units, but there are generally more joints where leaks can develop.

Service accessibility is generally somewhat better with linkage units . . . and units which are easily serviceable enhance safety.

PANEL SPECIALISTS who served up this information on Linkage-Type Power Steering were:

P. H. Pretz, Panel Leader
Ford Motor Co.

W. A. McConnell, Panel Secretary
Ford Motor Co.

W. K. Creson
Ross Gear and Tool Co.

C. W. Lincoln
Saginaw Steering Gear Div., GMC

C. F. Hammond
Gemmer Manufacturing Co.

T. H. Thomas
Bendix Products Div.,
Bendix Aviation Corp.

I. N. Schatzka
Monroe Auto Equipment Co.

Question: What is the effect on geometry in linkage installations, where the power cylinder replaces intermediate linkage and idler arm?

Answer: Such installations do destroy symmetry, but geometry errors are insignificant. One company has, in fact, been able to equal, or improve, geometry by judicious location of the frame bracket and by adjusting the relative length of the two tie rods.

Question: What are the pump requirements of linkage-type gears? Are capacity, flow, and noise greater or less than with integral types?

Answer: Capacities are similar because the work done is the same. Noise problems also are essentially the same, since pump installations are identical. Isolation of the noise may require different measures, however.

Question: With forces reduced on the gear in linkage-type systems, is there a corresponding reduction of gear-box cost?

Answer: The same strength is necessary in the manual gear in the event of power failure, especially where linkage systems are offered as optional equipment. Basic gear cost may be reduced, however, as confidence develops.

Question: Has there been any standardization of power system fluid? What maximum operating temperatures are reached and under what conditions?

Answer: Present requirements are low viscosity when cold and high viscosity when hot. This minimizes leakage. Automatic transmission oils seem to be the best fluid. Temperatures seldom exceed 200 F even under high ambients. A typical maximum seems to be 220 F at 90 mph.

Question: How does recovery compare with conventional steering? Is it more or less difficult to obtain than with integral gears?

Answer: There are problems because steering-wheel inertia, multiplied by the manual gear ratio, opposes recovery forces and operates the control valve in a manner to resist these forces. It is essential that the manual gear have a high reverse efficiency and low steering-wheel inertia, even more so than with the integral steering wheel type. Seal drag on linkage gears likewise becomes more important because of greater travel and smaller piston diameter. Seal friction becomes a larger proportion of the total forces.

Question: Can increased caster get back the recovery?

Answer: Yes

Question: In evaluating ratios, is steering wheel size considered?

Answer: Steering wheel sizes have not changed much, if at all, with the advent of power steering.

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Comet I Fits Smoothly Into BOAC Operations

C. H. Jackson, Manager, Operations Development Unit, British Overseas Airways Corp.

Excerpts from paper "A Review of Comet Experience" presented at SAE National Aeronautic Meeting, New York, April 22, 1953.

IN the first year of Comet operation, British Overseas Airways Corp. established an economic operation at about twice the previous cruising speeds. The corporation also confirmed certain favorable trends which should lead to lower costs and fares in the future. And its engineers learned a great deal that will influence future aircraft and equipment designs.

Comet I cruising and descent Mach Number is about 0.74. Yet there have been no worries about compressibility effects or control problems. In fact, we at BOAC contemplate with equanimity cruising in a future generation of aircraft to a Mach Number of 0.8 and retaining no more than, say, a 10% margin below the defined limit speeds. However, if increased speeds lead us to instrument-induced stability or complete dependence on electronics in flying controls, we would prefer to accept present Comet speeds, plus about 10% as our future limit.

Since we see no prospect of substantially im-

The Comet's Rise . . .

The Comet's history is a case of turning adversity to advantage. When World War II ended, the United Kingdom had no suitable piston engine ready to power a new fleet of civil transports. So the de Havilland Aircraft Co. Ltd., with the cooperation of British Overseas Airways Corp., went ahead and developed the first turbojet-powered civil transport, the Comet.

Actually the de Havilland design started off as an unconventional, high-speed mail plane. BOAC took an interest in it, and eventually it evolved into an almost orthodox design for a civil passenger transport, powered by Ghost centrifugal-compressor turbojets.

BOAC bought its first Comets off the drawing board, figuring that if performance fell at the bottom of the guarantee limits the plane would be satisfactory for medium-range operations, and if performance hit the top the plane would be fine for long-range operations. But before the plane reached the production stage, builder and buyer had agreed to aim at less-than-long stages for the Comet I and had changed dimensions accordingly. They also began planning for the Comet II and the Comet III, which are to be powered by Avon axial-flow engines.

The first Comet went to BOAC for development and training flying in April 1951. The initial Comet commercial flight took off from London for Johannesburg on May 2, 1952. BOAC experience during the ensuing year of service, up to the inauguration of the London-Tokyo flights, is reported in the paper from which the accompanying article is excerpted.

proved landing aids becoming internationally available for a good many years, we believe that attempts to raise cruising speed beyond Mach Number 0.8 will be limited by approach and landing requirements. It seems that we are not prepared for a substantial increase in approach speeds. So design for higher cruising speeds must be developed to retain at these speeds the same level of control and stability we now have.

The Comet has been operated to severe performance requirements through the same aerodromes as used by our Argonaut, Constellation, and Hermes aircraft. In fact, the medium-range characteristics of the aircraft have compelled the use of some secondary airports that would not normally be considered for the other aircraft. In general we have been able to use maximum permissible take-off weights and landing weights to the same extent as with the other aircraft. Where airport dimensions have prevented this, then generally there have also been limitations on the other aircraft. If in one or two places field length has limited the Comet then, at others, take-off climb has limited the older aircraft but not the Comet.

The introduction of turbine engines may also have favorable airworthiness implications beyond the details of operating techniques, engine location, and choice of fuel. I have in mind engine reliability; it seems that the records of jet-turbine failures in the United Kingdom, including of course military aviation, show a remarkable decrease in the failure rate in the critical conditions of flight at take-off and climb. I am told that a check on RAF experience made some months ago revealed that at take-off, where there is relatively little difference between the civil and RAF demands on an engine, showed the turbine failure rate to be about one quarter of that for civil piston engines. The trend has been confirmed in our own experience.

Apart from the extreme case of power failure, we are also finding that deviations of climb power and aircraft performance seem to be lower than for piston-engined aircraft. This would mean that the climb margins now required for our jet aircraft are in fact relatively high. Obviously, however, considerably more experience must be obtained before consideration could be taken of this in specifications or in regulations.

Table 1—Break-Down of Transit Time

Item	Time, minutes
Chocks on at	00
Steps in position at	02
Crew and ship's papers off at	03
Passengers off at	05
Dirty catering stores off at	05
Refuelling completed at	12
Flight plan checked, all ship's papers signed at	17
Disembarking load off at	17
Dead load embarked and servicing completed at	22
Passengers on and clean catering stores on at	24
All hatches closed and steps away	26
Engines started and chocks away at	31
Taxiing commenced at	32

Kerosene Preferred

We have had no major problems with kerosene and the Comet fuel system. There have been no cases of fuel waxing, and it seems that the design incorporates adequate filter capacity to avoid any trouble from water content. But we do not really know just how much margin we have. It is evident that fuel specification developments must be related more closely than ever to fuel system and tankage developments and to aircraft duration. On one aspect we are still adamant: that is our intention to avoid the wide-cut gasolines and adhere to kerosene or other high density, high flash point fuels.

Variations of fuel specific gravity caused overspeeding at take-off at one time. The amount of overspeed was only just outside the permissible limits and was readily controlled. However, it revealed the need for specific gravity corrections in the pump governors—a need which will become the more important if we have to consider in the future, say, two fuel specifications dependent on the operational requirement.

Forecast terminal weather data and actuals are proving more important than the en route data. As far as the latter is concerned we have been able to get by with the upper wind information available from the Radio-Sonde and Radar-Sonde systems. Our original planning estimates of wind strengths based on meteorological records have been generally substantiated. We have not been caught out, on commercial operations, by jet streams or clear air turbulence. Temperature variations have proved to be more critical in regard to take-off performance than cruising economy and so can be associated with the general need for terminal data. However, it seems that the background of high altitude wind data in the Far East and Pacific is not so comprehensive.

There were indications from our survey flights to Tokyo that the fuel reserve policy on this route may have to be generous until the forecasting procedures become more reliable. In fact jet-streams which were not forecast have been encountered on two occasions. Apart from the unfortunate direct effects on payloads, this lack of meteorological data is leading to our requiring structural cover for a higher percentage landing weight than we had originally thought necessary. The percentage is still lower than for our reciprocating-engined aircraft, which helps the aircraft designer, but does not ease our crew training problem.

The aircraft designers appear to have overcome

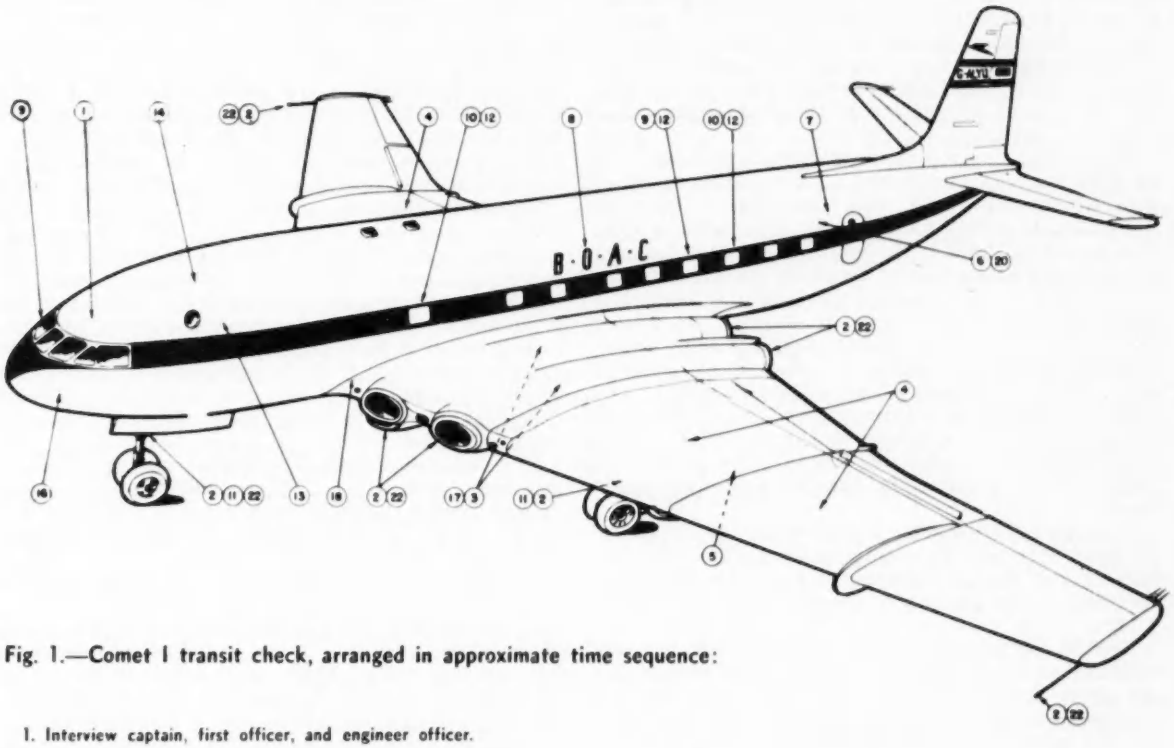

Fig. 1.—Comet I transit check, arranged in approximate time sequence:

1. Interview captain, first officer, and engineer officer.
2. Fit undercarriage locks. Fit blanks and covers.
3. Open engine cowlings. Check port and starboard engines for damage and leaks. Examine impellers and turbines for damage. Examine cowlings and inspection panels for security.
4. Examine tanks for water content. Examine tanks for leaks.
5. Refuel aircraft. Top up engine oil tanks.
6. Position sanitary truck and clean toilets.
7. Replenish water tanks in galley and toilets. Check levels and security of toilet filler caps.
8. Clean aircraft interior as necessary.
9. Examine windscreen and cabin window for cracks and crazing.
10. Check emergency exits for security.
11. Examine undercarriage strut and tire inflation. Check tires.
12. Change pressure controller silica-gel containers.
13. Release hydraulic system pressure. Top up reservoirs. Return ground test valve to normal. Check hydraulic accumulators.
14. Check oxygen system and top up.
15. Check that hatches and inspection panels are secure and that external surfaces and wing panels are OK.
16. Check windscreen de-icer tank level and top up.
17. Replace engine cowlings after inspection.
18. On completion of refuelling, turn refuelling master switch to "off." Check that vent caps, dipsticks, refuelling connections, and panels are secure after refuelling.
19. Radio report cleared.
20. Remove sanitary truck.
21. Position ground power unit for starting.
22. Remove and hand to engineer officer covers, plugs, blanks, and undercarriage lock pins.
23. Sign technical log.

the problems of airframe and engine anti-icing—after all there is plenty of heat available with the turbine, and it has been brought to the right places. No hazard has so far been encountered in our deliberate search for icing conditions or in the ice encountered en route on normal operations. However, we are still concerned about the possibility of encountering ice during night operations and so are keeping in contact with the development of new forms of ice detectors.

The speeding up of aircraft transit procedures helps to develop the full commercial advantage of the speed of the jet transport. The aircraft is making its own contributions, because already the reliability of the turbine is such that almost no powerplant checks are required at transits, and the operation enables all scheduled airframe and system checks to be conducted at the central engineering base in the United Kingdom. Transit times are therefore determined mainly by the speed of refu-

elling and by traffic and passenger-handling requirements. In fact, this equipment has really eliminated refuelling as a limiting factor on transit times. The Shell company, by providing large capacity tankers for use with the pressure refuelling system, have made fast transits practicable even with the large quantities of fuel that have to be handled. (Fig. 1.)

At present, our shortest transits range from 25 to 32 minutes. This compares with a minimum of 35 minutes for other aircraft. The tasks to be dealt with include refuelling, servicing, clearance of visas and manifests, and flight planning. Table 1 shows the average allocation of times at an African station on the Johannesburg service. Procedures generally are not so good at other stations, sometimes because deficiencies in communications delay transmission of meteorological or load and refuelling data. This combined with time on manifests and visas is limiting the value of short-cut flight-planning or simplified loading procedures. It is evident that full support must be given to the ICAO and IATA efforts to simplify the international paper work.

Even disinfection drill is a problem; at Khartoum we have been able to obtain authority for disinfection in the air but at some other transits, disinfection on the ground is losing eight minutes or more.

Engine starting on transits has not been a worry with the Ghost Comet. A mobile diesel generating set using a 100 bhp diesel is used. It provides a 1400-amp peak load at 28 v. Only a slight increase on this capacity will be adequate for the Avon engines in our Comet II's. But beyond this it seems that we might have to depart from electric starting if we are to have self-contained starts at an acceptable weight, and if we wish to avoid excessive expenditure on mobile starting equipment at the more remote airports. The query need not arise with aircraft limited to Europe or the United States, where fixed starting supplies to some internationally agreed standard may yet become available.

The shrill noise of the centrifugal compressor on taxiing is novel, but is very local and temporary. We are able to load up as with other aircraft. Engines are not started until air traffic control clearance is given at the taxi-ramp so that the aircraft moves off very rapidly and there are no complaints about noise. We anticipate that there will be even less cause for concern when the axial flow Avons, with their deep rumble, come into service.

Naturally we and the Ministry of Civil Aviation are concerned about noise at the maintenance area and at engine overhaul base. The problem is relatively straightforward at the latter, and the MCA is putting up directional sound-retaining walls in the airport maintenance area.

As to jet damage to airports—well, we have had no complaints so far. Naturally we avoid spilling kerosene on bitumistic surfaces. I suspect the damage problem arises only at military bases where the jet efflux from fighter aircraft is more likely to contact the ground at a high temperature.

Radio and Navigational Equipment

The radio aids in the Comet are conventional. However, a few operational problems have arisen because the speed of the Comet tends to highlight the deficiencies of equipment performance and thus increase the relative severity of the operating requirements. A typical example is the automatic direction finder (ADF); in this case the speed of the aircraft decreases the effective service range of the medium-frequency beacons, especially in the presence of noise or other interference. On the other hand, the speed decreases the time required to come within useful beacon range which is, dependent on other navigational aids, an alleviating factor.

Distance measuring equipment (DME) is an essential aid, not so much for directional navigation but as a means of cruise control. It enables descent to be initiated at the most economic point, and low level flight is kept to a minimum. We find that the great operating altitude of the Comet increases the effective range of DME to about 200 miles, which is considerably greater than for aircraft operating at lower altitudes.

The communication equipment has presented no problems. There is no reason why it should. Our only difficulty is again related to the speed of the aircraft and the fact that, with Comet I, stages average only 1200 to 1500 statute miles. These stages are covered so quickly that it is not possible to wait on entry to the appropriate flight information control before requesting weather forecasts and destination actuals. In general, it is necessary to request this information on initial climb. This emphasizes again the importance of good terminal weather forecasting, and it puts a premium on the earliest development of good high-frequency radio telephone communication. We find very high-frequency communications excellent with normal ranges of about 200 nautical miles due to the cruising altitude.

Suppressed Radio Aerials

The most interesting features of the Comet radio installations are the suppressed aerials. The operating results have been highly satisfactory. In no cases are our ranges inferior to those with standard aerials, and in some, particularly on high frequency with the fin structure acting as aerial, it is very much better. In general, aerial serviceability is high and there has been no need for remedial maintenance, except for some troubles with the fin high-frequency aerial.

Introduction of very-high-speed, very-high-altitude aircraft has not brought exceptional airframe or powerplant maintenance problems. In fact, the aircraft have fitted into our system rather more favorably than we had hoped. The Comet results are being attained with an entirely new airframe and engine for which modification and rectification time are naturally fairly high, particularly when compared with the Argonaut at a similar stage in its service life; for the Argonaut had, basically, well tried engines and airframe. In spite of this the capacity ton-miles per hour offered per man-hour of maintenance and modification are not much below that of the Argonaut. This of course results partly from the high speed of the aircraft, which safeguards any temporary high costs during the development period. As we move out of this first

phase of modification and development, there should be an absolute reduction of costs below Argonaut level. Meanwhile—and as anticipated—the high traffic load factors attracted by the Comet are helping to ensure a favorable overall economic result.

The only basically new check item was the introduction of a transit servicing check on cabin windows. This was established because of the window-crazing experience on other aircraft. No source of hazard was ever located, and this check has been discontinued as a routine.

The one really new inspection and maintenance complication has come from the power controls, which require more time and more specialized labor than for other aircraft, and provide additional components for the overhaul workshops.

Off-setting such points, the Comet cabin pressurizing system, tapped off the turbine compressor, shows an absolute saving on maintenance and overhaul against any reciprocating engined aircraft with its complex of engine-driven blowers. This points to another big saving—the absence of a complex and expensive powerplant build-up. Our spares and supplies planning can be based on the almost bare engine. There are other considerable advantages coming from the powerplant. For example, our airworthiness authorities do not call for a test flight even after changing four engines. Nor do we consider a test flight necessary. In contrast, a test flight is required if more than one engine is changed on any of our other aircraft.

The direct labor savings on engine change are equally marked. A Comet engine change requires less than half the man-hours for any other engine change. The comparison remains very favorable even against the more truly comparable change of a reciprocating-engined powerplant. It is partly because of this, and in spite of the relatively low overhaul life, that the overall man-hours for all engine changes are only about 2.5% to 3.5% of total maintenance, which is in the same range as for our other aircraft. But again, an absolute improvement is expected as we push up the overhaul life and improve reliability.

Reliability

Within the overhaul lives now attained, the reliability trends are fair. In fact, en route powerplant or engine incidents affecting operational regularity have been 20% less than with our other aircraft. The indications are that the percentage of unscheduled engine changes is tending, even at this early stage, to be less than for our other and well-established piston-engined aircraft.

Of the power-shut-downs in flight, none have occurred at take-off. Only two were initiated very shortly after take-off and these were due to false fire warnings—an accessory fault that we have all heard of before! In fact, the majority of power shut-downs have been due to accessory failures ranging from false fire warnings, through fuel flowmeter fluctuation, to an accessory shaft failure and some early failures of alternator cooling fan drive. There has been no sudden and unexpected loss of power, because of mechanical failure, at a critical stage of flight.

There has been one case of in-flight vibration leading to power shut-down, with subsequent inspection showing a bearing failure. The next worst issue has been temporary power loss, developed during the first part of the low power descent, and suspected to be due to ice-crystals in the low-pressure fuel filters. Both these problems have been adequately dealt with; the first by a change to the cooling flow; the second by increased capacity filters. The interesting feature of the second was its specific association with a particular sector and tanker fuel temperatures.

Contrary to expectations we have had no serious impeller or blade stone damage. The few cases of nicking have caused no concern. This good record is probably the result of the robust centrifugal compressor as much as our taxiing and runway procedures. However, we are fairly certain that when we start operations with axial-flow engines we will require an aerodrome taxiing procedure which will keep the intakes clear of stones thrown up by the slip-streams or jet streams of preceding aircraft. But this seems to be a less critical precaution than those taken with propellers on some current transports.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Discussion

R. L. McBrien
United Air Lines

Interested as we are in BOAC's experience with the Comet I, we feel that it may not be a complete indicator of the experience that would be obtained in United States airline operations with the type of airplanes contemplated for use in this country. The one consideration of size alone can be expected to introduce certain complications not now experienced with the Comet. It is expected that a U.S.-built jet transport will have at least twice the passenger capacity and a somewhat greater range than the Comet now being flown by BOAC. This will mean that longer periods will have to be spent on the ground at through stations just to unload and load the larger number of passengers and greater amount of cargo. This requirement will have its resultant effect on the economics of operating the transport.

We question that the Comet procedure of starting the engines and taxiing away from the ramp only after air traffic control clearance is received would be popular at the crowded air terminals of the United States.

We are inclined to question the procedure of not conducting a test flight after engine change, regardless of the confidence one has in the engine. In the age of high-speed flight it would seem particularly appropriate to conduct flight testing after engine change if only for checking the proficiency of personnel in accomplishing these changes. In the man-machine team with which the airlines are working, it is the human element that will be of greatest concern.

Military Tanks—

TANKS have come a long way in 10 years. Not only are today's tanks more streamlined, able to provide better protection for their crews, and capable of being operated with fewer personnel, but they also have power packages especially designed for them.

To be more specific, let's consider the improvements made in medium tanks from 1940 to 1952. Drawbar pull has been increased 75%, thus giving them more tractive effort. Maximum speed has been upped 38% to meet combat troop requirements. Weight, which is up 60%, provides better armor protection and ability to carry a deadlier weapon. Yet with all these increases, ground pressure, which should be as low as possible for best mobility, has been lowered by 30%.

One might think we have sacrificed fuel economy by increasing tank performance and armor protection. However, there is very little difference in fuel consumption on a ton-mile per gal basis between the World War II medium tank and the present-day version. (See Fig. 1.) Also bear in mind that we do not turn out new tank models and power packages each year. In the not too distant future, our power package will be considerably improved from a fuel consumption standpoint.

Now let's take a look at the improvements which have been made in—and what's in the offing for—such tank components as transmissions, engines, electrical systems, tracks, and bearings.

Transmissions

Since the last war, most track-laying vehicles have been equipped with two basic torque-converter type transmissions rather than numerous mechanical transmissions. Some time ago, a program was set up to accomplish three broad, major objectives:

1. Provide to the maximum extent possible a basic transmission that could be used for both wheeled and track-laying vehicles. This would make it possible to use a basic torque converter and gear train for wheeled vehicles, and by adding the necessary steering and braking mechanisms, get a complete transmission for track vehicles.

2. Obtain better fuel economy, more effective mid-range performance, and greater ratio coverage. (These combined objectives are based on the fact that tactical vehicles must perform over adverse cross-country terrain which means widely fluctuating demands for torque at the driving wheels or sprockets. Therefore, a transmission was desired that would automatically operate at peak efficiency under many changing torque demands.

3. Achieve simplification, both from operational and maintenance standpoints, and lower initial cost.

The objectives of this program have been achieved in many respects.

Fig. 2 gives an idea of the new transmission concept. It shows schematically the basic interchangeability plan for wheeled and track-laying vehicles.

An example of what to expect in an advanced transmission is shown in Table 1. By providing more ratio coverage, adding the intermediate lock-up feature, and automatic downshift, it is possible to obtain better fuel economy (especially on cross-country terrain); to make mid-range performance more efficient; and to eliminate to a certain extent dependence on the driver.

In track-laying vehicles, the principal factor that increases initial cost and maintenance of the present transmission is the differential steering mechanism. In the advanced transmission, the clutch-brake type that will be used will incorporate the latest controls for the clutches and brakes so that maneuverability and drive control will not be adversely affected. This will produce a large saving

An Ever-Improving Species

Major W. O. Miller,
Project Engineer, Combat Vehicles, Aberdeen Proving Ground

Based on paper "Military Vehicles" presented at a meeting of the SAE Southern New England Section, Hartford, March 4, 1953.

in the number of pieces required, saving critical material and providing a simpler product.

Engines

Progress made in tank engines since World War II has been remarkable.

Today there are two aircooled engines that have been especially designed and built for tanks. (They supersede six improvised engines used in medium tanks of World War II vintage.) These two engines, which have many standard and interchangeable parts, are used in all modern tanks and numerous track-laying vehicles.

Some of the important improvements made in the engines used in 90 mm gun tanks are shown in Table 2. Compared are power-package removal time, cooling horsepower, power-package weight, engine weight, and horsepower per pound of engine weight for the 500-hp World War II engine and the 810-hp present-day engine.

Both of the aircooled engines being used today are destined to be the last of the line of conventional gasoline engines used in tanks. Right now, tests are being conducted on carburetor-replacing systems which discharge fuel into the induction system of Otto cycle engines . . . and results of this research program look promising. Fuel injection such as this would be desirable for these reasons:

1. Better cold-starting characteristics.
2. Less possibility of hydrostatic lock.
3. Improved fuel economy.
4. Better operation at high altitudes.
5. Less tendency to backfire.
6. Less detonation.

The long-range research program underway calls for multi-fuel engines operating on a diesel cycle and, naturally, gas turbine cycle engines. One of these two will replace the present line of tank engines if testing proves its worth.

Electrical Systems

Recent changes in the main engine generator used in certain tanks have made it possible to obtain 300 amp output with the engine idling.

This is most desirable in modern tanks since electrical requirements are great. It means that a tank can idle its engine while on outpost duty and operate as much electrical equipment as desired

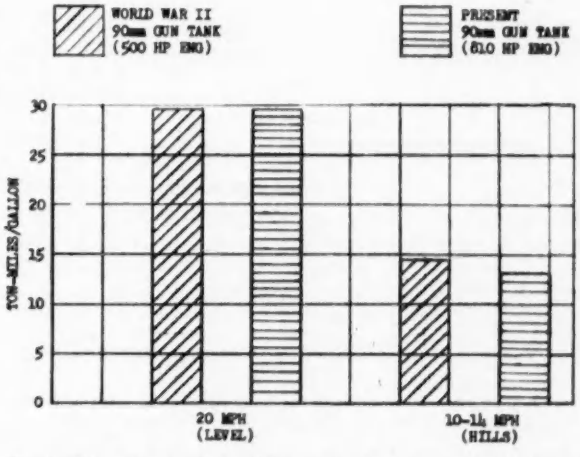

Fig. 1—There is very little difference in fuel consumption between World War II 90 mm gun tank engines and present-day ones despite increased performance and armor protection in modern tanks

Table 1—How Advanced Tank Transmission Will Differ from Present One

Features	Present Transmission	Advanced Transmission
Gear Ratios		
Low range	Yes	Yes
Intermediate range	No	Yes
High range	Yes	Yes
Reverse range	Yes	Yes
Mechanical Lock-Up in		
Low range	No	No
Intermediate range	No	Yes
High range	Yes	Yes
Automatice downshift from high to intermediate range	No	Yes

Table 2—Improvements Since World War II in 90 mm Gun Tank Power-Package

	World War II 90 mm Gun Tank	Present 90 mm Gun Tank
Power-Package Removal Time (Man-hr)	18	4
Gross HP Used for Cooling (%)	17	13.6
Power-Package Weight (lb)	6949 (500 hp)	7013 (810 hp)
Engine Weight (Includes cooling accessories) (lb)	3399 (500 hp)	3392 (810 hp)
HP per Pound of Engine Weight (hp/lb)	0.15	0.24

without fear of draining the battery. This feature is also exceptionally beneficial for cold-weather starting.

Tracks

The life of rubber track has been more than doubled since 1946 through the use of cold-processed synthetic rubber. (This fact has caused the majority of combat units to demand rubber tracks rather than steel ones.) Today the trend is toward increased life of rubber track and—if present experiments are successful—a sizable increase in track life can be expected over our already much improved tracks.

Bearings

To conserve strategic materials, as well as reduce overall vehicle cost, we are now using some nylon and compressed cotton fabric bearings. Results are promising.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

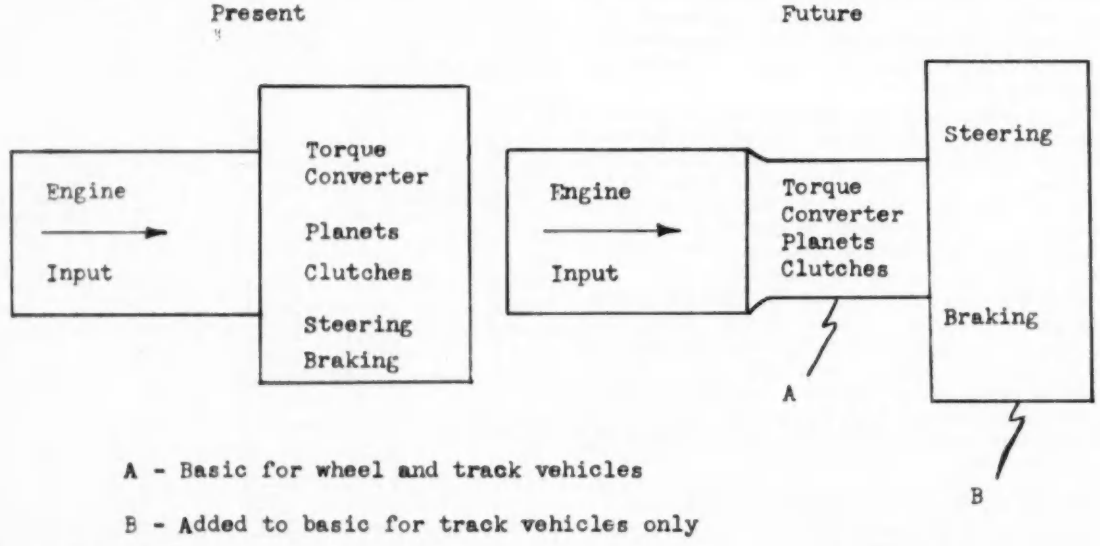

Fig. 2—This shows schematically the basic interchangeability plan for transmissions for wheeled and track-laying vehicles. Idea would be to have a basic torque converter and gear train for wheeled vehicles, and by adding the necessary steering and braking mechanisms, get a complete transmission for track vehicles

CRC IN '53

Current research program shows industrial projects on increase as military projects still hold firm.

SINCE the start of the Korean invasion, the emphasis on military projects within CRC activities continually increased until the fall of 1952, when it reached a peak. At this time, approximately 70% of the CRC investigations were either being carried out at the express request of the Military Services, or were activities in which they had expressed a definite interest and to which they were contributing support.

This general trend toward an increasing amount of military work has now changed, so that the figure has been reduced to approximately 65%. This is due to the gradual development of increased industry activity, which was evident last year, and has been further intensified this year, rather than to a slackening of military work, although there may be some tendency to reduce military work in the future.

The CRC is currently working on 52 individual projects dealing with 35 separate subjects. Work on eight individual projects, representing three new subjects, an amplification of two subjects, and three projects which are carried out on an annual basis, was initiated during the past year. Work on eight projects has been completed since the issuance of the 1952 Annual Report.

A short review of some of the projects being carried on by the Coordinating Fuel and Equipment Research Committee and the Coordinating Lubricant and Equipment Research Committee follows:

Fuel and Equipment Research

In addition to the separate categories of motor, diesel, and aviation fuel research, the CFR Committee activities cover a number of projects of wide general interest.

Temperature Measurement:

The instantaneous - temperature - measurement project, covering the work which was originally done by four university laboratories for the CRC, is being continued by two university laboratories, the Massachusetts Institute of Technology and the University of Wisconsin, with the financial support of the Office of Ordnance Research. The sound-velocity technique developed by MIT and the absorption technique developed by the University of Wisconsin have been shown to be capable of measuring instantaneous temperatures inside an operating Otto-cycle engine, and it is felt that further development of these techniques would permit their use as lab-

oratory tools. Action has been taken recommending that joint support from the Military Services and industry be proposed for the third year of this work. The costs for the first year's activity were borne by the CRC, the second year's work is being supported by the Military, and it is felt that the costs for the third year should be jointly supported.

Combustion Fundamentals:

The fundamentals of combustion project at Battelle Memorial Institute is now in its third and final year. This study of combustion by means of high-speed photography uses a single-cylinder engine which has been equipped with a quartz plate in the cylinder head to enable simultaneous direct-flame and schlieren photographs to be taken. The first films showing simultaneous photographs of the direct flame and the schlieren image have now been taken, and are being studied. The ability to take these simultaneous pictures was one of the primary purposes of this research and one of the basic reasons for having the work done at Battelle Memorial Institute.

Gasoline Storage Stability:

The CFR storage stability program is continuing. Approximately 568 samples of 55 blends of motor gasoline were stored under desert storage conditions at Yuma, Arizona. The original program was initiated in October, 1951, and a supplementary program started in January, 1952. An investigation of bulk storage in 100-barrel tanks at Aberdeen Proving Ground is also in progress. Limited storage and laboratory tests are being conducted on a small number of aviation gasolines to supplement information obtained in the 1944 desert storage tests on aviation gasoline. Selected jet fuels were placed in desert storage in March, 1952, and the one-year sampling has been completed.

The Bureau of Mines is conducting a program on diesel fuels under the sponsorship of the Western Petroleum Refiners Association, and the results of this study are being coordinated with the information secured in the CRC activity. The Panel on Motor Fuels has an engine program under way at Southwest Research Institute, employing a series of fuels at various gum levels, as a means for determining the significance of laboratory gum test results in terms of the effect on the performance of engines. The stationary engine tests represent an amplification of the work conducted during the last war, and the program involves engines different from those previously studied.

Ordnance Fuel Needs:

One of the projects of the Motor Fuels Division carried out at the request of the Military Services covered assistance to the Ordnance Corps in conducting octane number requirement and vapor lock tests on new designs of Ordnance equipment at Yuma, Arizona, during the summer of 1952.

In this program, the Ordnance Corps conducted all the test work, with CRC providing only supervisory assistance, in line with the general policy of assisting the Ordnance Corps in the development of test engineers capable of evaluating military equipment. In addition, fuel volatility and cold-starting tests were conducted at both Fort Churchill, Canada, and Devils Lake, North Dakota, to evaluate the fuel volatility requirements of the Ordnance equipment at extremely cold temperatures in terms of the currently-supplied military specification fuels.

Based on the test data which were obtained in this program, a number of changes have been made in military vehicles to improve their fuel-handling and cold-starting characteristics, and also to reduce their octane number requirements. As a result of the extensive vapor lock testing which has been carried out at Yuma, the Ordnance Corps has also revised its acceptance tests for new vehicles to provide that a special vapor lock test fuel, equivalent in operation to an 8-psi Reid vapor pressure fuel operating at 125 F, shall be used in the vehicles during the cooling, hill-climbing, and sand-mobility tests. The inclusion of this provision in the acceptance requirements of the Ordnance Corps will insure that, in the future, all vehicles which are accepted by the Ordnance Corps will have demonstrated their ability to operate with military specification gasoline at ambient temperatures of 125 F.

Octane Survey:

In 1952, the Motor Fuels Division continued its broad study of the octane number requirements of passenger cars as they are operated in the hands of the public. The 1952 program was concerned with the testing of specific makes and models which were of particular interest because of recent engine and/or transmission designs to determine the effect of these design changes on the vehicle octane number requirement. A paper will be presented to the SAE covering the results of the 1951 and 1952 surveys.

A great deal of interest has developed in the evaluation of part-throttle knocking characteristics of the newer design cars, since it has been shown in some cars that the part-throttle octane number requirement is higher than the full-throttle requirement. The effect of hills is also being studied because of its effect on the requirement.

Vapor Lock:

Vapor lock and associated problems of stalling and hot starting are being studied by a Group of the Motor Fuels Division. The current program involves:

(1) the development and proving out of a technique by a number of individuals with standard 1953 vehicles at a centralized location;

(2) the evaluation of a group of control

cars of several makes by individual laboratories located in the various geographical areas as a means of studying the effect of temperature level on the occurrence of the various problems associated with volatility;

(3) a survey of the difficulties actually being experienced in service through the organization of survey teams in various areas;

(4) analysis of available crankcase oil dilution data prior to the formulation of a specific program on this phase of the problem.

Deposits:

A symposium on the subject of combustion chamber deposits and their effect on fuel octane number requirement and power output of gasoline engines was held in Detroit this past year. The symposium covered a two-day period, during which approximately 20 individual papers were presented, and a general discussion was held. A large amount of information was presented, indicating the wide interest in the problem. An analysis of the data is now being made to determine whether the CRC can assist the automotive and petroleum industries in studying part of this problem.

Road Rating Techniques:

The CRC road test exchange program is still aimed at determining the reproducibility and repeatability of the various fuel road rating techniques. A detailed program, prepared with the assistance of mathematical statisticians, indicated that repeatability and reproducibility required improvement. A supplemental program will be carried out, designed to evaluate improvements in these techniques before the test program designed to study the effect of design and operational variables on fuel rating is started.

A number of laboratories have been determining ratings of fuels, using a variable-speed technique with a single-cylinder engine, as a study project in the CFR Motor Fuels Division. A comparison of these data with the results obtained in the equipment survey and the road test ratings with the same fuels has indicated that the variable-speed technique gives results more closely in line with full-scale operation, particularly with the new-design vehicles, than do the conventional Motor and Research number ratings on the same fuels. Because of the interest in this activity, work on it will be extended. A complementary study involving the possible use of the temperature-density concept for correlating full-scale fuel ratings—obtained either on a dynamometer or on the road with laboratory engine ratings—is also being studied.

Diesel Locomotive Tests:

The Diesel Fuels Division is continuing its study of the effect of high-sulfur low-cetane high-end-point fuel in railroad diesel service. Tests have been completed on four roalroads using Electro-Motive Division locomotives, and on one railroad each using Alco and Baldwin locomotives. A progress report on this phase of the project is being prepared. Two additional heavy-duty freight service tests have been arranged on the Pennsylvania and the Chicago and North-Western Railroads, using Alco and Baldwin locomotives, respectively. These tests should be completed in the fall of 1954.

Fuel Bomb:

The work of the U. S. Bureau of Mines on the constant-volume diesel fuel bomb is continuing in 1953. The investigations to date have demonstrated that the bomb is an adequate test tool for use in the laboratories of both the petroleum and automotive industries. Work is currently under way covering the testing of a wide range of pure hydrocarbons to provide a background for determining the extent of correlation of the bomb data with data secured in engine operation. To insure the most useful test program, provisions have been made to include representatives of a large number of diesel engine builders in this activity.

Sub Engines:

At the request of the U. S. Navy Bureau of Ships, a CRC Diesel Fuels Division Panel is serving in an advisory capacity to the Navy in programming full-scale submarine engine tests. This test program is designed to evaluate the effect of fuels from foreign sources, which might be expected in the case of an emergency, on the operation of submarine engines under the new type of operating conditions involving snorkelling for relatively long periods of time.

In addition to fuel characteristics, lubricating oils, engine operating conditions, and engine design factors are being studied. Another Panel is assisting the U. S. Navy Bureau of Ships in studying the effect of these same fuels on small-craft propulsion engines being used by the Navy.

Jet Fuels:

The work of the Aviation Fuels Division is now entirely devoted to the subject of gas turbines and their fuels. Because of the increasing interest in the commercial utilization of gas turbines in aircraft, each of the aviation fuel projects has been reevaluated to insure that the fuels which might be considered for commercial use are included in the test programs. The vapor-locking characteristics of gas turbine fuels have been the subject of considerable activity in the CRC.

Because of the increasing speeds of military and

civilian aircraft, with their corresponding increases in skin temperatures, this work is being extended to cover a much wider range of temperatures and pressures, and also a much wider range of fuels. This study, which covers the problems of vapor locking, fuel evaporation in tanks during flight, and fuel tank pressurization required to prevent excessive fuel losses, is being carried out both at the Thompson Products Laboratory in Inglewood, California, and at the California Institute of Technology.

Ice in Turbine Fuel:

The study of low-temperature pumpability of gas turbine fuels and of filter icing has been temporarily stopped, pending a reevaluation by the Military Services of the seriousness of the problem. The Air Force, with the assistance of the CRC, ran full-scale service tests at the Eglin Field Cold Hangar, and also full-scale mock-up fuel system tests at Wright Air Development Center. These data, together with the data which had been previously obtained in the CRC programs, have indicated that, with proper housekeeping to eliminate excess water from the fuel at the time of aircraft servicing, the filter icing problem is essentially eliminated. Provisions are being made to obtain actual flight test data to corroborate these indications.

Turbine Fuel Combustion:

Two projects on the combustion characteristics of gas turbine fuels are under way, with the objective of developing a test or tests which will provide significant and relatively simple means of evaluating combustion characteristics of gas turbine fuels with several parameters, such as combustion efficiency, flame velocity, quenching distance, and minimum ignition energy. The work includes the testing of regular fuels, as well as pure hydrocarbons, in bench-type apparatus, small-scale combustors and full-scale combustors of various types. Emphasis has been placed on covering a range of combustion design and operation. However, it has become evident that, with the rapid changes in full-scale engine combustion design, the laboratory test equipment must be modified to provide operating conditions more in line with those in the full-scale engine.

A Group in the Aviation Fuels Division is serving in an advisory capacity to the Air Force, and has prepared a proposed program to study high-rate fueling of turbine aircraft. Actual conduct of this test program has been delayed, pending the installation of special test equipment at Wright Air Development Center, where the tests will be conducted with CRC supervisory assistance.

Lubricant and Equipment Research

The investigation of the engine-lubricant relationship in Ordnance vehicle engines, including the aircooled tank engine and the aircooled liaison aircraft engines, is continuing. The aircooled tank engine tests are being run at Aberdeen Proving Ground and at the Detroit Tank Arsenal. The liaison aircraft engine tests are being conducted under Ordnance contract at the Ethyl Laboratories in Detroit. Upon completion of each section of these tests, an Inspection Team of the Coordinating Lubricant and Equipment Research Committee reviews the test and inspects the engine. This test work has indicated that some engine modifications are necessary for optimum performance, and these changes are being incorporated in the new engine designs. Fleet tests also are being conducted at Southwest Research Institute to study the operation of Ordnance vehicles on the various military specification oils.

The fuels and lubricants which are being used in these test programs are being made available to the various Groups of the Coordinating Lubricant and Equipment Research Committee to insure that the maximum utilization will be made of the field service data being obtained. These data will be of particular use in the development of research techniques in the future.

Rear Axle Problem:

A number of companies in the petroleum industry have indicated concern with rear axle failures in passenger cars, as indicated by surveys which they have made; companies in the automotive industry are now checking their service information on the subject. The CLR Gear Lubricants Group, as a result, is now conducting a complete survey of all industries involved to determine the extent of the problem of rear axle failures, and to what extent the lubricant-equipment interrelationship is involved.

Upon completion of this survey, a study will be made to establish whether a cooperative project should be set up in the CRC to study this problem.

Lubes for New Engines:

A new problem on engine oils has been presented to the Coordinating Lubricant and Equipment Research Committee. The engine manufacturers have indicated that a problem of film strength or EP characteristics has developed in the higher horsepower output engines now being installed in passenger cars. This problem, which has been with the industries for a long while, has shown up as excessive wear on cams, cam followers, and gears, and it has been indicated that both engine design and lubricating oil have a definite effect on the problem, and that a cooperative project seems desirable. A Group has been organized to review this subject and prepare a proposed program for future work.

CLR Test Engine:

At the November, 1952, meeting of the Coordinating Lubricant and Equipment Research Committee, the CLR Oil Test Engine Group was authorized to "make arrangements for design studies with suitable manufacturers, and also come up with a suit-

able design," and to "complete their studies, and make a selection of an engine manufacturer to build the engine; then come to the CLR with a definite recommendation, so that there will be no delay if the CLR approves the design."

Since that time, the Oil Test Engine Group has been actively following this directive. Invitations to submit proposed designs based on the CLR Survey Team findings were tendered to six companies, all of whom were considered by the Group to be capable of satisfactorily handling the assignment. Of the six manufacturers, two companies indicated their desire to submit designs. After careful consideration of the detailed designs, the delivery schedules, and the cost estimates furnished, the Group agreed that, subject to the approval of the CLR, the proposal submitted by the Laboratory Equipment Corp. would be accepted, and the CLR, at its June, 1953, meeting, approved the report of, and the action taken by, the Group.

The new engine was designed to be capable of meeting the requirements set up in the survey of over 40 laboratories conducted in 1952. The first batch to be made up will be used in technique development work, prior to construction of a larger number of engines, for general industry use.

Lab-Made Deposits:

The reproduction of engine deposits and wear in the laboratory, similar to those found in actual field operation, has been the objective of one of the projects of the Coordinating Lubricant and Equipment Research Committee. This study, covering a number of engine designs, piston-ring combinations, and operating conditions, is a very active project. The results being obtained have indicated that it is possible to reproduce these deposits and wear in the laboratory.

Airframe Lubes:

A comprehensive study of airframe lubricants and bearings is being carried out at the request of the U. S. Air Force and the U. S. Navy. The purpose of this work is to determine the lubricant requirements of the various mechanisms built into the airplane so that changes in both the aircraft or accessory design and the lubricant can be made to obtain the best overall effectiveness. Included in this study are the problems of rust prevention, high-temperature operation, and fret corrosion, as well as instrument bearing and plain bearing problems.

One of the important factors in this study is service test data, which has been very difficult to obtain in the past. Extensive field test programs on a number of these problems are under way, and it is expected that adequate service information will be made available as the individual tests progress.

Piston Engine Lubes:

In accordance with a request received from the Air Development Force, an extensive program was initiated to study the use of compounded lubricating oils in reciprocating aircraft engines. Flight service tests are being conducted by the Air Force on a series of oils in B-36 and B-50 aircraft, and a full-scale multi-cylinder engine test program designed to evaluate overall engine performance was carried out by the Military Services. These data were made available to the members of the Aircraft Reciprocating Engine Lubricant Performance Group, who, using such research techniques as are made available, are attempting to establish a series of techniques, covering such items as spark-plug fouling, preignition tendencies, and so forth, which will correlate with field service data. The majority of the flight tests have been completed and it is expected that a report on the work can be prepared this year. Two additional flight test programs, which have not been completed, will be made the subject of a supplemental report.

A study of the various methods by which the development of improved bearings and improved lubricants for aircraft powerplant use might be accelerated is the subject of an activity of a Group of the Coordinating Lubricant and Equipment Research Committee. This study is involved particularly in the field of the large high-speed highly-loaded bearings, such as are used as main rotor bearings in the gas turbine powerplants.

The Group recommended that, because of the high cost of test equipment, the progress be speeded up by the Air Force making available to industry test machines for research and development work. A cooperative design for a test machine for the study of high-speed, high-load main-rotor bearing problems was developed, and the Air Force has arranged for the construction of one of these large machines and two smaller machines for general industry research and development.

Among the other CRC projects is one undertaken in November, 1952. A joint CFR-CLR Group has been set up to serve in an advisory capacity to the Ordnance Corps in the preparation by Ordnance of a descriptive booklet on handling fuels and lubricants in military equipment.

In addition to CRC groups working on specific projects, several groups are making valuable contributions in a supervisory or service capacity. For example:

- The Special Report Review Group reviews all reports prepared in connection with projects initiated at the request of the Military Services which are classified, and approves them for official transmittal.
- The CRC Editorial Group reviews and clears all CRC papers before they are presented to the sustaining members.
- Fuels and Lubricants Coordinating Groups make arrangements for supplies of materials necessary for research investigations of the various groups.
- The Pacific Coast Liaison Group helps expedite the presentation of problems and viewpoints of companies operating on the West Coast.

Why Airplanes

THE airline's eagerness for the day when late sleepers in New York can be whisked by a jet transport to Seattle or Los Angeles for lunch is matched only by their lament over the price of necessary equipment as variously quoted in the press. To provide a common starting point for a study of equipment costs, the prices quoted for commercial transports from 1933 through 1953, plus a quotation or two for 1954 and 1956, are presented graphically in Fig. 1.

The adjusted Comet prices represent our best approximation of how these planes would be priced if the same wages were paid in the United States and Great Britain. Prices in the $3,500,000 to $5,000,000 bracket give airline operators and aircraft manufacturers cause to ponder seriously the economics of jet transportation.

Obviously, the prices shown are for very different articles. The simplest denominator is weight. Hence, if we reduce these prices to the basis of price per pound of weight empty we get a more rational picture (Fig. 2). Here weight empty is defined as the weight of the structure, plus powerplant and fixed equipment.

For an even closer analysis let us select three planes similar in physical respects to the Boeing 247-D, 307, and 377. We are able to take basic cost data for such a series, adjust it to one uniform quantity, one uniform profit rate, and eliminate all cost advantage gained by concurrent production. When we do this we get Fig. 3, in which the upper line reveals the gross price increase and the bottom line the same data reduced to a per pound of weight empty basis. By this conversion the 3420% price increase from 1933 to 1949 is reduced to a 359% price increase. If we make an adjustment for inflation the price increase is even less. A pound of Model 1949 could do more than a pound of its predecessors. If we divide our costs by block speed we actually find a decreasing trend so far as actual capacity of the hardware is concerned.

During the past 20 years increases have been made in speed and range, yet accidents to planes and passenger fatalities have decreased. Increases have also been made in reliability, time between engine overhauls, and in passenger comfort through attention to problems of insulation and vibration. All of these advances must have cost some money.

Fig. 4 shows the sales price per pound of weight empty classified by recurring and (based on 75 planes) nonrecurring costs, and subclassified by major cost elements. It shows that basic engineering and basic tooling increased 151% and 102% respectively between Models 1933 and 1949. Our requirements of increased speed, range, comfort, safety, and reliability have cost us heavily in the engineering and tooling fields. The growing recognition of the worth of a pound of weight in terms of increased operating revenue or of speed and range, has dictated not only fineness in design, but a tremendous and unceasing search for lighter, stronger alloys and materials; for fastening devices, molding and forming devices to yield smooth contours, plus durable trouble-free service; and for the optimum in light-weight and reliable equipment.

Significantly, the basic tooling increase has occurred largely since the Model 1939 era. Modern transports with their heavier structural members, increased aerodynamic smoothness, and extremely weight-conscious design, have required more and heavier tools in order to hold necessary tolerances, to yield reasonable interchangeability of major components, and to make possible the construction of complex machines with normally skilled manpower.

Of the recurring elements, sustaining engineering and sustaining tooling show a much more marked increase from the Model 1933 to the Model 1949 than does the larger element of production cost. Sustaining tooling in particular has increased in order to make the necessary changes, corrections, and to maintain the greater number of more complex tools now required. It appears axiomatic that the more complex the design, the more complex the tooling and the more difficult it will be to accomplish any given change with proper coordination.

Increase in direct charges is attributable largely to new city and state taxes, increased cancellation costs, increased use of consultants, and greater travel to determine customer's needs and to maintain proper liaison with suppliers.

Note that the percentage of nonrecurring cost to total cost has increased from nine or ten percent to slightly more than 14% for the Model 1949. Let

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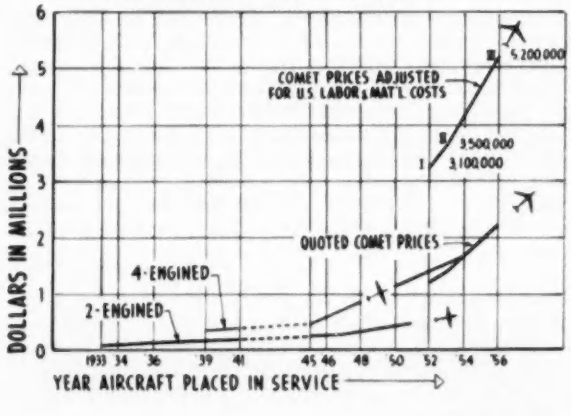
COMMERCIAL TRANSPORT AIRCRAFT

NEWSPAPER SALES PRICES



Cost More and More

J. W. Barton, Boeing Airplane Co.

Based on paper "Factors Influencing Airplane Costs" presented at SAE National Aeronautic Meeting, New York, April 22, 1953.

us trace the significance of this by comparing the nonrecurring costs for an airplane whose weight empty is 90,000 lb as they would have been in 1933 or 1939 with what they would have been in 1949. In 1939 the airplane would have been engineered and tooled for about $14,500,000 as contrasted with over $31,000,000 in 1949. Of course, the 1939 model would not perform as well or be as comfortable as the 1949 model, but it would have cost less. And this is what is revealed. Under 1949 conditions the manufacturer incurs a substantially greater first or starting cost before any planes are produced. This means a much greater financing problem. Even more important, the decision in original pricing to base price on a certain quantity becomes just about twice as important. Had the manufacturer in both instances based his price on 75 airplanes, but had succeeded in selling only 70, he would have lost around $950,000 in 1939 as contrasted with over $2,000,000 in 1949.

This same element holds a further risk. Should there be changes in design as there are bound to be, more dollars worth of engineering and tooling will be scrapped and more dollars worth will be required to make the corrections than in the period of the 1930s. This real threat makes the manufacturer do everything possible to insure the establishment of design before going into production. He will call more upon the services of his planning personnel in production and method studies work to insure that the best tools and sequences are used so that costly changes may be avoided later on. This is also conducive to increased costs—the direct costs in engineering and planning and the indirect costs of overhead service personnel.

Of all the increases, the smallest has occurred in the elements of production labor and raw material. The former made its major increase, 24%, from Model 1933 to Model 1939, and during this

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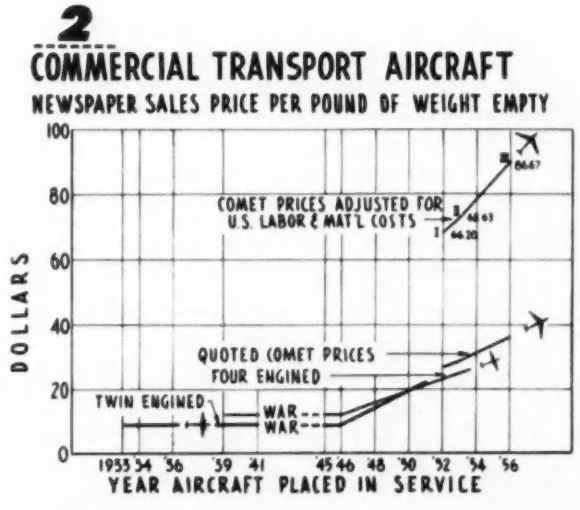

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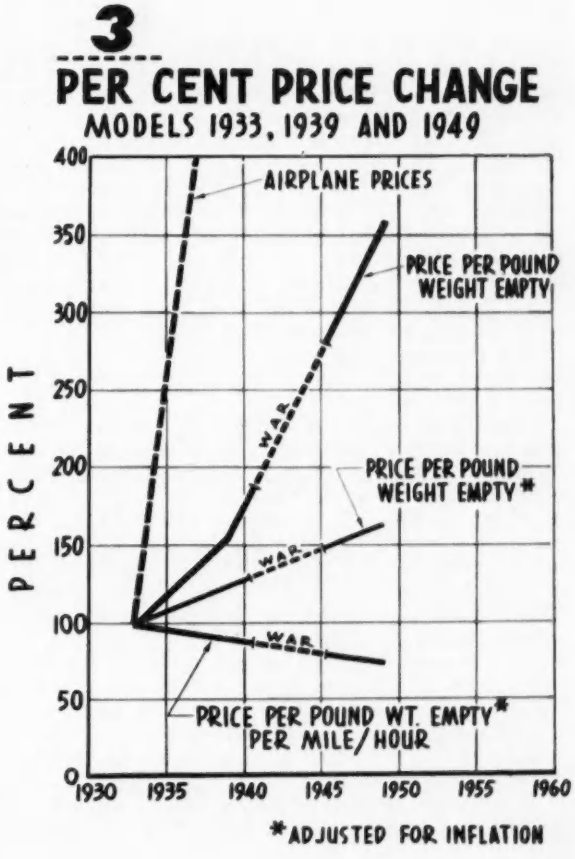


4

SALES PRICE PER WEIGHT EMPTY POUND

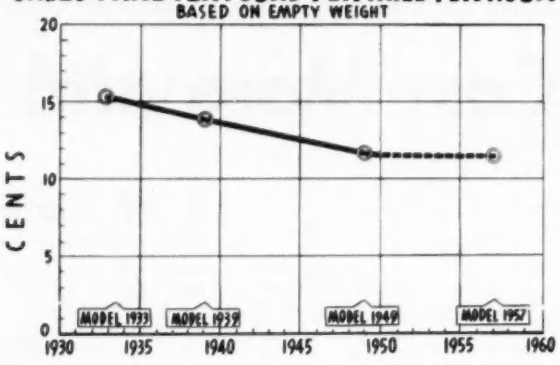
				% INCR. 1933-49	
NON-RECURRING					
BASIC ENGINEERING	+0 57	+0 89	+1 33	151*	?
BASIC TOOLING	1 62	1 24	2 28	102	
SUB TOTAL	2 19	2 13	4 61	114	
RECURRING					
SUSTAINING ENGR.	0 56	0 68	0 96	71	
SUSTAINING TOOL.	0 26	0 29	0 96	269	?
PRODUCTION	16 96	21 22	25 20	49	
SUB TOTAL	17 78	22 19	27 12	53	
DIRECT CHARGES	0 10	0 68	1 04	940	
TOTAL	20 03	25 00	32 77	64	?
% OF NON RECURRING TO TOTAL	10 7	8 5	14 1		
MODEL	1933	1939	1949	1957	

ADJUSTED FOR INFLATION

5

SALES PRICE PER POUND PER MILE PER HOUR*

BASED ON EMPTY WEIGHT



*ADJUSTED FOR INFLATION

same period structural efficiency increased nearly 75%. This efficiency is indicated by the pounds of gross weight per pound of structural weight—which for Model 1933 was 2.03 and for the Model 1939 was 3.54. This was a period of transition from relatively simple to complex forming and fastening techniques, a period when manufacturers really learned how to work with the new materials. True, there was an actual increase in cost per pound, but it was small in contrast to the increased effectiveness of the product generated.

From Model 1939 to Model 1949 the increase in production labor cost was practically negligible despite technological improvements. The reason for it is the resultant of three major forces. First, very substantial decreases in cost per pound were effected so far as structural cost per pound was involved. Our records indicate a better-than-28% decrease in manhours per pound of structure. Second, there was a large increase in the complexity of installations. The percentage of weight accounted for by nonstructural or installation items increased only slightly, but manhours per pound for this material increased by more than 60%. Third, there came a sudden realization that installation costs were getting out of hand, and to combat this cost it was necessary to employ time and method study techniques and increased production planning and tooling techniques.

Production overhead accounted for the largest single increase in production costs from Model 1933 to Model 1939. Although it is probably only coincidental, the 73% increase is virtually identical with the increase in structural efficiency for that period. Overhead increase can be explained in two ways. Some of it is due simply to the large type of organization required to build heavy aircraft. The larger the organization, the greater the degree of specialization of overhead type functions; and after a certain point in growth coordinative functions must be added to insure a balanced operation of the whole organization. Overhead growth also comes about because of the additional planning required to get the right part installed in the right place at the right time.

Purchased equipment other than engines and propellers—which equalled about half the raw material cost for the Model 1933—has now become the equal of raw material cost. The increase is actually better than 145%, or the greatest of any of the production elements. Its significance is two-fold. There is its own cost increase per se, and its effect on production labor and overhead requirements as well as its reflection on the added complexity of the engineering and tooling job to be done. The latter is far the most significant. We conclude that the purchased equipment element and its related effects offer one of the greatest, if not the greatest, threats of increased airplane prices.

In reviewing the airplane cost picture we have found the elements which have been increasing at an accelerating rate are those of engineering, tooling, production overhead, and purchased equipment. What can we tell of the future, basing our guesses on commercial transport cost experience and some experience with military jet aircraft? Experience indicates that the effect of changing from a piston-driven to a jet-driven airplane is not localized in the powerplant area. Rather, the increased performance which the jet makes possible develops problem areas in each of the specialized fields where existing research and production techniques are insufficient to supply the needed answers.

In his Wright Brothers Lecture, William Littlewood provides an excellent listing of the major problems which will beset jet transports. Here are a few of them:

1. Protection of airplane and "live load" from turbine wheel failure.
2. Provision for cooling jet engine hot parts to assist crash safety.
3. The re-lighting problem, intake icing, and ingestion of foreign objects.
4. Insurance against noise-induced failures.
5. Better cockpit engineering.
6. Increased fire protection.
7. Insurance of system's integrity—that is fail-safe engineering.
8. Designing to eliminate materials which produce toxic compounds in event of fire.
9. Seat design improved for accident survival.

10. Prevention of control freezing at altitudes.
11. More adequate and specific provisions for floatation and ditching of land planes for over-water use.
12. Need for increased engine efficiency and economy and all the related problems of thrust variation with temperature, improvements in engine overhaul periods, and development of ground handling techniques.

To list these problems is not to indicate that we are faced with insurmountable obstacles but rather to suggest that we should not expect to have all these development problems solved for free.

As regards jet powerplant costs, recent quotations indicate that we should expect to pay approximately $460,000 for the engine. For an 86,000 lb weight empty airplane this would yield $5.35 per weight empty pound as compared with $3.50 for the Model 1949, which is a substantial increase. To arrive at a reasonable estimate of jet transport prices of the future we have tried plotting historical data against every conceivable parameter and have found that the most meaningful and apparently consistent relationships were those involved in plotting the price per pound of gross weight versus gross weight times block speed. If we assume that Jet #1 is going to have a gross weight of about 186,000 lb at a block speed of 460 mph we arrive at a price of $24.50 per pound of gross weight which multiplied by 186,000 lb gives a total price of 4.56 million dollars. Since previous history has been normalized to a quantity of 75 we have an average price for 75 airplanes.

Converting this price back to a sales price per pound per mile per hour, based on empty weight, should provide some perspective as to economic possibilities (Fig. 5). In terms of their capability these pounds of hardware are not too bad even at the estimated price. The price converts to 11.5¢ per lb of weight empty per mile per hr as contrasted with 15¢ for the Model 1933, which represents a 26% reduction in terms of a price based on speed capability. Though reasonable in terms of the product delivered, prices of this magnitude represent a substantial financial problem to both airlines and manufacturers.

To reduce the cost of future aircraft, manufacturers should continue their efforts toward cost reduction, and both airlines and manufacturers need to minimize changes from the basic design. Changes instigated by the CAA, customer, or contractor can well make or break a project. CAA changes on the Stratocruiser added hundreds of pounds to the weight empty of the plane and cost many thousands of hours. Customer changes are extremely difficult to control, and engineering changes originated by the contractor while within his control are still somewhat of a menace to low costs.

While changes from the basic specifications are bad cost-wise, changes between customer's specifications are disastrous. Total cost in the first instance may be expected to decrease from unit to unit on about an 85% curve. Customer-to-customer changes may quickly alter this improvement rate to 90%. For 75 airplanes this would increase the cost by 30%. On the Stratocruiser program, nearly one-third of the company's total loss is attributed to cost overrun on changes.

If the following prescription is taken seriously and continuously it will decrease airplane sales prices dramatically:

1. Minimize changes from basic specifications.
2. Eliminate all but minor variations in planes for different customers.
3. Minimize the use of unproven equipment.
4. Minimize luxury accommodations.
5. Pool purchases of aircraft and spares.
6. Order spares early enough to permit concurrent production with aircraft parts.

The last item has been and will be reasonably accomplished. The first four items apply equally well to both patients—airlines and manufacturers. Like most patients we have known all along that this is the way to reduce. The will power to push ourselves away from the drawing board and typewriter needs stimulation.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Discussion

In the discussion which followed the presentation of this paper, **William Littlewood, American Airlines, Inc.**, pointed out that the manufacturers who made the largest number of aircraft have paid the largest dividends. He also declared that the manufacturer has no right to pass on the cost of speed given by taxpayers' money. In regard to making changes he said, "I accuse the manufacturers of being sissies. The only changes we insist on are the things that won't work." Only a small percentage of the total number of gadgets is changed, and this has no major effect on cost.

Raymond D. Kelly, United Air Lines, Inc., suggested that the Comet should not be used as an alibi. We didn't get where we are by competing on labor costs, he said, and added that we should take labor costs as a challenge and do better with our own advantages. Some customer changes are worth while, he declared, and since ideas change and experience accumulates, too much standardization can inhibit progress. Mr. Kelly took exception to Items 3 and 5 of Mr. Barton's prescription for cost cutting by asking how proven equipment could be used on jets when nothing is proven, and how the purchase of spares could be pooled when it wasn't known what spares would be needed.

In rebuttal, the author stated that Boeing made a good profit this year, but produced no commercial aircraft, while the manufacturers of commercial craft, with one possible exception, have made no profit since the war. In regard to relative labor costs, he pointed out that on the Comet the average wage was 55 cents an hour, while here the wage was $1.87, which was quite a challenge. On the other hand it had been estimated that here we pay $12 per lb of thrust, whereas in England the figure is $18, indicating that the challenge has already been accepted. He also pointed out that the taxpayers buy research, while the airlines want development and must pay for it themselves.

Review of Facts on

Treatment	Facts
Metal spraying	Can be used with nickel, Monel, stainless steel, Stellite, molybdenum, tantalum, and other metals. Coating may be built up as thick as 8 in. Method has not been used extensively.
Cementation	Can be accomplished by coating with powdered metal, by subjecting piece to gaseous metal atmosphere, or by immersion in molten metallic salt. Powdered aluminum fused to ferrous pieces works well. Immersion of ferrous parts in chromium salts at 1800 F coats them with chromium films 0.0004 to 0.0010 in. thick.
Phosphating	Dipping iron and steel parts in certain phosphate solutions develops thin layer of iron phosphate plus zinc or manganese phosphate. Film is soft, granular, and about 0.0004 in. thick. Treatment is easy and cheap. Used on piston rings and cylinder liners and on gears to prevent scuffing during initial running period. Tests show that phosphate treatments can double the load gears of Rc 60 can bear but give no improvement on Rc 40 gears.
Iron oxiding	Involves spraying superheated steam at 1000 F on iron or steel in the relative absence of air. Leaves thin, very hard, relatively short-lived surface. Treatment is quick and very effective on cast iron. It is useful also on steels which can stand the 1000 F temperature without detempering. Process is used on parts like piston rings and cylinder liners to prevent scuffing during initial mating of new surfaces.

Wear-Resistant Coatings

R. H. Bancroft, Executive Engineer, Perfect Circle Corp.

Based on paper "Wear Resistant Coatings for Ferrous Metals" presented at the SAE Annual Meeting, Detroit, Jan. 13, 1953.

Treatment	Facts
Sulfiding	Requires immersion of piece in an aqueous bath of alkali and sulfur at 250 F. Said to etch out free ferrite, a constituent incapable of hardening, leaving only hard constituents. Has a relatively short life. Reported to reduce scuffing of cast iron cylinder liners during break-in by 90%.
Nitriding	Suitably alloyed ferrous metals are exposed for 40 to 90 hr in dry ammonia gas at 950 F. Develops hard surfaces measuring around Rc 67. Nitriding impairs ductility and is therefore not suitable for parts that must flex.
Carburizing	Low-carbon steel pieces are packed in carbon and soaked in molten sodium cyanide or in a suitable carbonaceous atmosphere in a furnace. Raises surface carbon content so that on quenching the surface attains a hardness of Rc 50 to 60. Surface is long lasting. Process is not applicable to cast parts.
Chromium plating	Chromium is electroplated in solid or porous films. Film is very hard (900 to 1050 Bhn) and has high (12×10^6 psi) modulus of elasticity—a combination of properties which has been observed to give good wear resistance. Chromeplating is used very successfully on piston rings and cylinder liners to prevent wear. For rings, solid plating is favored.

Schools Lack ABC's for

Aspiring Fleet Operators

Henry Jennings, "Fleet Owner"

Based on secretary's report of Round Table on the Education, Development, and Future of the Motor Transportation Executive held at SAE Summer Meeting, Atlantic City, June 9, 1953.

THERE are so many facets to a fleet operator's job that it appears some parts of his training will have to be compromised. No candidate is likely to live long enough to get it all and still have time for a useful career. Best way to arrive at quick absorption of desirable qualifications is a university course beamed directly at the job.

Trouble with present courses at institutions of higher learning is that they tend towards specialization in other directions. This leaves the transportation executive with a number of blind spots that he cannot correct. Being something of a jack-of-all-trades, the fleet-executive candidate requires wide latitude in his choice of subjects . . . and this is frowned on severely by established schools.

Take the case of a fleet operator who knew when he entered school that he was headed for fleet operation. To get the subjects or courses which would be valuable for his chosen work *he had to major in French*. It was the only way he could be permitted sufficient electives.

Some specific knowledge of these subjects and courses is desirable: mechanical engineering, electrical engineering, mathematics, accounting, safety, physics, chemistry, English, business administration, salesmanship, and psychology. In addition, a fleet operator should know the fundamentals of the business employing the fleet, if it is not a transportation enterprise. He should also have some time-and-motion-study experience and be familiar with Interstate Commerce Commission requirements. This is a pretty formidable list and considered opinion is that it better be worked out with educators.

American Trucking Associations, Inc., is contemplating the employment of a full-time staff man to provide continuous liaison with universities. His job would be to promote a better end product in the graduating class. One fleet operator has wrestled with three successive deans at his alma mater without any very promising results.

Lack of training and recognition has resulted in the fleet operator becoming a top sergeant in his own baliwick without ever becoming company brass or, for that matter, ever catching the brass ring. Many trucking company executives started out as truck drivers, and as the industry and fleet grew, they lived through all the growing pains. Thus old timers had a working knowledge of the various things that go to make up a business.

But those days are past. Hired hands are now called upon to step into departments and projects which require more specific knowledge. And they have to get this knowledge somewhere. This calls for more and better formal education.

Leader of the Round Table on the Motor Transportation Executive was E. P. Gohn, Atlantic Refining Co. Serving with him were: Henry Jennings, secretary, "Fleet Owner"; Robert Gardner; J. W. Lord, Atlantic Refining Co.; T. L. Preble, Tidewater Associated Oil Co.; H. G. Steigerwalt, Supplee-Wills-Jones Milk Co.; and H. L. Willett Jr., Willett Co.

Do Automotive Jobs Need More Appeal?

Interviews with 1307 members of a graduating class of a Pennsylvania high school disclosed that only 25 of the youngsters wanted any part of the automotive business. Using employment statistics, this number should have been 226.

Of the 25 who selected the automotive industry, only five intended to continue their education. The rest wanted to be truck drivers with the exception of a few mavericks who thought they would be mechanics.

Efforts are now being made to enlist the cooperation of the Rotary Club and the Pennsylvania Motor Truck Association in guiding these lads into the business in a way that they can continue their training.

The Role of Public Information in the Safety Cause

1953 Beecroft Memorial Lecture

By W. Earl Hall

Editor, The Mason City, Iowa, Daily Globe-Gazette

The Seventh
SAE Beecroft
Memorial Lecture

Delivered by W. Earl Hall at the National Safety Congress In Chicago, Ill., Oct. 19, 1952

FOREWORD

I BEGIN this pleasant assignment in deep appreciation of the high honor conferred upon me. It constitutes the one finest compliment that has come my way. It's flattering—and humbling—just to be bracketed with those six truly distinguished personages in the field of safety who have received this award since its inception in 1947. . . . Paul G. Hoffman, Thomas H. MacDonald, Arthur T. Vanderbilt, Sidney J. Williams, Rudolph P. King and Franklin Kreml.

When my notification reached me, my emotions were a bit mixed. I was thrilled with the distinction but terrified by the assumption that a certain degree of scholarliness would be expected of me—a singularly unscholarly individual. My anxiety along this line prompted me to consult a friend of long standing in the safety cause.

"As matters stand," I wrote him, "I'm getting most of my information on the subject by merely listening to myself and reading my own clippings. That obviously won't make my monograph sound very scholarly. I must have at least a few footnotes."

The tone of the reply I received may serve to identify this friend for those who know him—and most of you do. It led off:

"Look, Character . . . What the Beecroft people want is for Hall to give them what HALL thinks, not what Hall gets out of a book. I have talked this over with Sidney Williams and he agrees completely that you would not only be wasting your time with your reading but that you actually would be straying away from the course they undoubtedly want you to follow."

This counsel from Paul Jones, fortified by consultation with Sidney Williams, has been my compass and guide in the preparation of what follows. I have tried to observe a Longfellow admonition: "Look then into thine heart and write." I have taken my subject seriously—but not myself, I hope you will agree.

IT was just 30 years ago that I began to think of safety as being something more than the personal problem of a certain young managing editor who that year had acquired his first automobile. You've guessed right; it was a Model T!

For the past quarter of a century—26 years to be exact—I have participated rather actively in what could be referred to as the organized safety movement. First it was at the local level, then at the state level, in recent years at the national level.

In my own community I had a part in developing an organization and instituting a program designed to make a frontal attack on our accident problem. Down through the years, I might add, that program has succeeded in the degree that it has had dedicated leadership and active public support.

At the state level I managed to become the first president of the Iowa Safety Council by getting in on the ground floor. I was founder of the organization. That, incidentally, is one way to get ahead!

At the national level I have served in the official family of the National Safety Council; I've been chairman of the National Committee for Traffic

Safety (made up of organizations with membership rolls containing more than 100 million names) and five years ago I succeeded Paul G. Hoffman as Public Support Chairman for the President's Highway Safety Conference. (I could hear myself rattling in his shoes.)

For the past 22 years—since July 30, 1931, to use the precise date—no issue of the daily newspaper over which I preside as editor has ever been permitted to go to press without at least one editorial preachment about some aspect of safety. In recent years, it's been two each day on my editorial page and a safety art feature on Page 1.

I don't think I would be over-shooting the mark if I calculated the distance I've traveled by motor, train and plane in trying to get other people to be careful of their own lives—and mine too, of course—as twice the distance around the earth at the equator, or maybe even about a fourth of the distance to the moon.

My recital up to now, I freely concede, sounds like quite a bit of boasting. And may I observe, it's so intended. I've been deliberately building myself up for a big let-down. I am using this method to point up and spell out what seems to me to be an underlying fundamental in the field of public information in traffic safety.

In spite of all the time, energy, thought, voice and white space I've devoted to the safety cause, I don't know for sure—and most assuredly I couldn't prove—that I have ever so much as saved the life of ONE human being. I think I have—and I like to believe it may be some wonderful little guy in my home block—but I don't KNOW.

And that's something inherent in the safety cause. Our concern always is to PREVENT something from happening. If it happens, our efforts have been futile. Well, it's extremely difficult for me as a newspaper editor and radio commentator to generate any prairie fire of enthusiasm for something that didn't and isn't going to happen.

By the nature of things, we in the informational and "sales" side of the safety program are forced into a heavy reliance on statistics to get across our story. And off-hand, can you think of anything more unglamorous than a statistic—unless it be a whole row of statistics?

If somewhere along the line in my lifetime I had leaped off the dock in front of my Clear Lake summer home and rescued somebody who was going down for the third time, I wouldn't be in doubt whether I had saved somebody's life. Nor would anybody else. But when in the printed or spoken word, I merely admonish against the practices which invite drowning, or some other form of accidental death, I am setting up no *corpus delicti*.

In this respect our problem in traffic safety is not unlike that of the doctor who specializes in preventive medicine. His calling doesn't possess the glamor that attaches to wielding a surgeon's scalpel, or even that which accompanies coping with disease after it strikes. The practitioner of preventive medicine too is trying to stop something before it happens.

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In my files is one sheaf of correspondence I shall always treasure. On top is a letter from a country newspaper editor in my home state who in all kindness and courtesy put this question to me:

"Why, Mr. Hall, are you going to so much trouble trying to keep people from getting killed on our highways? What great difference does it make whether one meets death on the highway and gets it over with in a hurry or waits to take his turn in bed, from disease?"

Curiously enough I was never able to give that particular friend an answer I felt would satisfy him. It won't, I'm sure, surprise you to learn that he was suffering from an inoperable cancer. A few months later death from that ugliest of all diseases did overtake him—in bed.

The poignancy of that note caused me to do some real soul-searching. As I re-examined my own motivations in the safety cause, I tried to rise above such things as quibbling with the fallacious assumption in the letter that death on the highway is always instantaneous. We all know it isn't. But that wasn't the real issue raised by my friend.

Clearly the basic difference between him and me lay in the fact that for him hope had gone out of life whereas for me life was—and still is—something sweet and precious. I not only want to live out my own span but I earnestly desire this for my family and all my fellow human beings.

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And this leads me to what has been the central thesis of my personal philosophy from the very beginnings of my contact with the organized safety movement. It's expressible in this simple declaration:

"When nine out of ten people in America want safety—want safety enough to pay the price of safety—we'll be on the way to having safety almost overnight."

I've shifted my thinking on a number of other theories and assumptions having to do with safety—but not on this one belief that undergirds my entire safety credo.

I hasten to assure one and all that I am not laboring under the impression that there is anything profound or earth-shaking about either the sweeping premise I've stated or about the logic with which I try to support it. I may even have borrowed both because original ideas in safety are rare indeed. It would be hard for me to prove that I ever sired one.

Some will assail my stated thesis on the grounds that it is "oversimplifying an essentially and inescapably complex and complicated problem." In fact, these are the precise words of one indictment on file in my office.

If you are one who inclines toward that point of view, I ask your indulgence for a few moments as I contemplate the chain reaction of consequences which might well ensue if nine out of ten Americans really would give top priority to safety, as distinguished from accepting safety as just a pretty abstraction.

First of all, let's dispose of that tenth person—the one without a due appreciation of safety. Or rather, let's leave him to the law enforcer who would proceed to the task not merely with majority blessing but with unmistakable majority mandate.

It would be forever established that sitting at the wheel of an automobile is a PRIVILEGE, not a RIGHT—a privilege to be withdrawn if abused.

Officials who now have good reason to believe that cracking down on all offenders might separate them from their much-needed mealticket would be made to understand that anything less than complete and courageous enforcement of the law would have exactly that effect. There just wouldn't be any doubt about either their duty or their authority.

Secondly, the educator would know that he or she was going to be judged on results, not on costs alone. Every youngster would meet up with the teachings of safety on the first day of kindergarten and there would be a daily contact with safety until high school graduation, and indeed into college.

ALL schools would do what many—but not nearly enough—schools are doing today in the field of behind-the-wheel driver training. At the appropriate age every youngster would know how to operate an automobile safely or be barred from driving if found deficient in any essential qualification pertaining to body, mind or attitude.

Educational psychology, I think, could be counted on to condition the mind of future drivers along proper lines. It could be brought home—and it must be brought home—that reckless driving doesn't require even an ounce of brains. It isn't the "smart thing" to do. To the exact contrary, it's stupid. The heavy foot and light head are its principal ingredients. The Grade A Birdbrain can do it—and usually does.

But driving prudently does require some intelligence. It is the true mark of the smart person, as distinguished from the smart aleck. Safe driving is one of the best ways conceivable for the individual to demonstrate that society's investment in his education wasn't wasted.

Like the enforcer, the educator is waiting for that commanding voice of popular opinion to say: "You just go ahead and do the best job you possibly can; we'll pick up the check!"

But the real test of this thesis of mine would be found over in the third compartment of the safety triune, ENGINEERING. In that area we desperately need the kind of objective re-examination of existent streets and highways that only a visitor from another planet could bring to the assignment.

What would the detached observer—that man from Mars—have to say about this one commonplace on our roads:

Two cars coming at each other at a collision speed of from 100 to 150 mph and in traffic lanes separated from each other by nothing more substantial than an imaginary line?

To make a grim situation even more grim, one or both of the cars may be in faulty mechanical condition; one or both of the drivers may be under the influence of alcohol, or otherwise handicapped. And to add further interest to an already interesting set of circumstances, toss in the fact that when passing another vehicle, the cars racing at each other in the same lane, without even the benefit of the imaginary line!

You and I accept all this as "just one of those things." But would the man from another planet? Or, indeed, would an American public committed to solving the traffic accident problem, irrespective of cost?

The visitor from Mars, after he quit standing on ceremony would call us earth-bound creatures crazy to countenance such a standing invitation to death on our highways. And an American public truly alerted to the danger inherent in the commonplace would acquiesce in that verdict.

Within the past five years a group of legislators, dignified by its designation as a "fact-finding committee," made what purported to be a study of the highways of my own state. After much fanfare, the group concluded that not within the foreseeable future, and probably never, would there be need for what was scornfully referred to as "superhighways."

That conclusion, I submit, reflected a pathetic blindness to the one greatest contributor to the human slaughter on America's highways today—head-on crashes. Channelized traffic on main arteries, with a physical separation or barricade between opposing lanes, is not, I grant, the complete solution to the problem. But it IS the starting point.

Engineers operating under a mandate to build safety into roads without primary regard to dollar cost would also have a plan for holding to a minimum, if indeed not wholly eliminating, collisions at right-angles as well as those involving head-on impact. Cloverleafs and other designs for separating grade crossings can be had—but at a price.

In August of this year, the Automobile Manufacturers' Association—never to be confused with the mythical Man from Mars about whom I have been talking—published a report which contained these three rather startling claims:

1. A really adequate system of highways may call

THIS is the seventh of ten Lectures by recipients of the David Beecroft Memorial Award, presented annually for "substantial contributions to the safety of traffic involving motor vehicles."

The Award originated in the terms of a bequest to the Society of Automotive Engineers by the late David Beecroft, SAE president in 1921.

Previous awards were made to Paul G. Hoffman, Thomas H. MacDonald, Arthur T. Vanderbilt, Sidney Williams, Rudolph F. King, and Franklin M. Kreml.

Copies of this Lecture are available in booklet form from SAE Special Publications Department, at 50¢ a copy to SAE members and $1.00 a copy to nonmembers.

for an expenditure of as much as $20 billions.

2. The lack of such a system is costing the motoring public at least $3 billions every year.

3. Two in five traffic deaths could be avoided through needed improvements on roads and streets. That would mean saving 15,000 lives in the U.S. this year.

A public committed to the attainment of safety on our highways would weigh the oppressive economic toll now being exacted by accidents against the financial outlay that would be required to build roads as safe as human ingenuity can engineer and construct them.

The starting point for all this, I repeat, would be to have nine out of ten Americans sold on safety as something real, something vital—not merely as an abstraction like unto beauty or righteousness to which all too many of us are prone to pay mere lip-service.

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Now we're ready for a consideration of ways and means to bring about that situation in which there will be overwhelming insistence that our accident problem be solved, irrespective of dollar cost. That, incidentally, leads us closer to the subject of this essay, "Public Information's Role in the Safety Problem."

Proceeding from the assumption that the way to prevent accidents is about as well known and as amply authenticated as is the way to prevent smallpox, or any other communicable disease, I've come to place foremost emphasis on creating the DESIRE FOR SAFETY in the public, with the various media of communication serving as the principal implement in the process.

There have been times during my contact with the safety cause when I supposed more knowledge to be the primary key to the problem. My reasoning was that if people could but know how to live safely, they would, more or less automatically as rational beings, do just that. In short, I regarded the human animal as being primarily controlled by impacts on his mind.

With each passing year, however, my thinking on this subject has been undergoing some revision. Today the evolution has progressed to this point:

I no longer think the acquisition of more knowledge is the most important thing in safety. What's ever so much more vital is that people be induced to MAKE USE OF the knowledge already possessed.

A way must be found to convert people to the idea that practicing the recognized rules of safety is an indispensable element of good citizenship.

A way must be found to drive home the idea that observing the rules of safety in everyday life is a cardinal tenet of the Christian ethic which keeps reminding us: "I am my brother's keeper."

And this, I insist, is an assignment for an evangelist. Would that we could summon to the task another Apostle Paul, another John the Baptist, another Martin Luther, another John Wesley—or maybe even another Billy Sunday.

I may be all wrong but it seems to me that we've now gone just about as far as we can with a safety appeal which is addressed mainly, if not solely, to the mind. The appeal from this point on, if we're to get anywhere, must also be directed to the heart and soul and spirit of man.

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What I'm really suggesting here is that the motivating force back of the safety program be lifted to a higher level, given a loftier keynote, if you please. Man does not live by bread alone!

While I'm not averse to the "And Sudden Death" approach in my safety evangelism, I am persuaded that the scare psychology cannot be the principal arrow in our quiver. Let it be used where it alone will work, just as it's permissible to apply pressure to the pocketbook nerve to bring some folks into the safety camp. But let's not lay our foundations on fear.

For a further commentary on this general proposition, we have only to turn to the subject of peace and war. Even though we KNOW that another war would be catastrophic to our civilization, the preparations for a next war move feverishly ahead.

On a war correspondence mission I saw and heard and felt the buzz-bombs as they fell on London. I heard and felt—but I didn't see, because they move faster than sight—the V-2 rocket bombs. And I inspected a platform in Normandy from which 100-ton projectiles with 25-ton war-heads were about to be launched when our boys moved across the channel.

There, thought I, as I gazed at that enormous ugly pile of concrete in a peaceful wooded valley two miles west of Cherbourg, is not merely the herald but the blueprint of our next war—if next war there's to be. But I didn't know the half, or even the tenth, of it. I didn't know about the A-Bombs at that time. Now we either have or are about to have H-Bombs, infinitely more destructive.

But in the face of all this, man continues to build his armaments and to stake his faith in war as the ultimate determiner of international quarrels. That's why I have had to conclude that the scare approach will not suffice in any safety program. Fear psychology may be helpful in some cases. When it is, use it. But it doesn't contain the full or final solution to our problem.

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A safety evangelism comparable in zeal and results with the evangelism which marked the first two centuries of our Christian religion would lead to a universal acceptance of personal responsibility for creating conditions of safe-living and security.

Every enlistee in the crusade for safety, as he proceeded to his hour-to-hour duties, would be asking himself: "Am I by my acts bringing danger to anybody else?" He would be thinking beyond himself.

In the unfolding of this pattern, all of us would, I'm sure, be utterly amazed by the extent to which SAFETY and COURTESY are SYNONYMOUS. It would be driven home to us that of all the ingredi-

ents which go into this thing called safety, none is quite so important as a decent consideration of the well-being and comfort of others.

While safety responsibility starts with the individual, it doesn't end there. To the question, "What can I do to promote safety?" is joined another question: "What can WE do?" And therein a community safety awareness is born.

No, there's nothing inward-looking or isolationist about the sound and intelligent safety attitude. Just as individuals in a community committed to safety get together and promote an effective safety program, so communities sold on safety join hands and promote safety on a state and nationwide basis.

But a hard look at the national scene makes it painfully clear that the mass conversion to the traffic safety cause about which I've been talking has not yet taken place in our fair land. It not only isn't at hand, it isn't even in sight.

Too many of us are still yawning in the face of mounting tragedy.

Too many of us get all hot and bothered about a multiple-death train or airplane crash in some distant place while blinding our eyes to the day-to-day traffic deaths right at home.

Too many are still saying: "It won't happen to me—to somebody else, maybe, but not to me." This malady is identifiable as "Otherfellowitis."

These are the things that have led me to the conclusion that the safety cause in America today stands in greater need of evangelists than of technicians. It isn't additional information, primarily, that we require, I repeat; it's a spur and a burr to induce us to apply what we already know.

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Now to return to that previously expressed wish for another Apostle Paul or John the Baptist. I'd even settle for that best known evangelist of our day, Billy Graham, if he could be induced to direct his genius for mass salesmanship to the ideal of a safer, and therefore a happier, world.

But in all of this I am indulging in wishful thinking. Down in my heart I know no such miracle-working evangelist is going to show up. I know that if the task of evangelism is to be accomplished, it's going to have to be done by the workers and with the tools at hand.

And that's where our newspapers, our magazines, our radio, our TV, our outdoor advertising, our movie screens and all other media of public information make their front and center stage entrance.

My own field of greatest interest, and perhaps greatest competence, is newspapering. Although I have had some contacts with radio over a period of 15 years, they have been principally of an editorial opinion character. Of the million words or so I've spoken in a once-a-week commentary the past ten years, at least 100,000—the equivalent of a standard-sized novel—have been addressed to the safety subject.

While I shall be dealing mostly with the newspaper and radio approach to safety in what follows, I should like it to be clear that I am fully cognizant of the substantial contributions which have been made—and will be made—to accident prevention by the other media to which I have referred.

Each has its proud record, as I was privileged to observe during the time when I watched the whole panorama of public information from a vantage point in the National Safety Council and the National Committee for Traffic Safety, as well as in connection with several conferences on highway safety called by the President.

With each passing year I am the more persuaded that every appeal possible should be made in disseminating the safety story. Once, as I've already mentioned, I was squeamish about resorting to the so-called horror approach. But not any more.

My reasoning now—and it shows up in my editorial, radio and public speaking treatment of the safety subject—is that human beings just don't all respond in the same way to the same stimuli. Some people, I'm convinced, DO have to be scared into being careful. And I know of no case in which the scare method ever made a person LESS careful.

There was a time too when I considered it indefensibly crass to make the exorbitant cost of accidents a principal incentive to safe practices. But, again, not any more. There's an abundance of evidence that the pocketbook nerve controls the safety attitude and behavior of many Americans, both sexes and all ages.

Generally speaking, accidents are no laughing matter. And yet posters which point up the human foibles at the base of many mishaps have proved enormously effective. I don't draw the line on the smiling approach nor do I frown on the tear-jerker which causes people of a certain psychological makeup to be careful—through misty eyes.

It follows, therefore, that as an editor I would welcome any contribution that can be made by any of these companion or competing media. Each does have a contribution to offer and its effectiveness, reverting to my thesis previously enunciated, will be proportionate to the degree those at the helm have been "sold" on the safety cause.

In this connection I'm harking back to a conversation I once had with the president of a rather sizable life insurance company. He took the bald position that existent slaughter on the highways is but the inevitable price civilization must pay for progress. It's too bad, of course, he explained, but there's little or nothing we can do about it.

That impressed me as being defeatism of the worst kind. What kind of progress is it that exacts an annual toll of 35,000 or 40,000 lives and a million and a quarter injuries on our highways? A person obsessed with that kind of fatalism is a doubtful asset in any business and, most assuredly, a medium of communication guided by such a melancholy individual would have nothing inspired to give the safety cause.

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The converse of this situation is that the responsible head of a newspaper, magazine, radio, TV, theater or outdoor advertising firm who started each new day with a resolve to do something about making the world a little safer—and therefore a little happier—WOULD find a way to help. The wish would be father to appropriate action. Let's consider a case in point:

One day last January, readers of the Akron, Ohio,

Beacon Journal opened up their newspaper to find an eye-arresting page of pictures in the place where usually they come upon their editorials. In 11 horizontal strips were shots of 91 pairs of shoes—shoes of all kinds, conditions and sizes.

"Empty Shoes!" was the heading, displayed in bold-faced type. Beneath the head was an explanation in simple, appealing language:

"On this page today are pictured 91 pairs of Empty Shoes. They represent the 91 persons who lost their lives in automobile accidents in Summit County in 1952. Here are the 91 best reasons for safer walking and safer driving during the coming year.

"Who were these 91 victims of speed, recklessness, carelessness and lack of alertness?" the writer asked. And then, in dramatic directness, he proceeded to answer his own question.

"The youngest," he explained, "was four months old; the oldest was an 81 year old pedestrian." So many were men, so many women; so many drivers, so many passengers, so many pedestrians, etc.

The appeal which followed was unashamedly a tear-jerker.

"These," quoting again, "are merely statistics—and Empty Shoes mean far more than that. Empty Shoes mean a family left fatherless or motherless. They mean the end of life's bright promise for young men and women. They mean swift painful termination of childhood's happiness, an unhappy end for old age."

"No one," the writer continues, "really knows what Empty Shoes mean—except the families of these victims. Others may forget, but the widows and widowers, the orphan children, the parents and brothers and sisters—they remember. The living drivers remember too, even those who are blameless. The horror of a fatal accident cannot be erased from memory."

"But Empty Shoes," the editorial admonishes, "tell only a fraction of the story. In addition to those who have died, there were more than 3,000 injured in traffic. Many of them are crippled for life; others bear permanent disfiguring scars. Some spent months in hospitals.

"If these Empty Shoes could talk, they would beg us to drive safely and walk carefully—to stay alive and let others live.

"Many of these Empty Shoes may have pressed hard on accelerators or jammed at brakes in that final second. Some may have stepped from safety into the path of an oncoming car. Some were hurrying; some were at play. Some Empty Shoes were merely standing still.

"Today they have one common characteristic: All 91 are EMPTY!"

Then this conclusion:

"These Empty Shoes are both an indictment and a challenge. They are an indictment of every violator of a traffic law. They are a challenge to all of us, as individuals and as a community, to cope with our traffic problem. They demand more police enforcement in municipalities and in the county. They demand stern justice and severe penalties.

"These Empty Shoes challenge us to walk and to drive so carefully that we will not be involved in accidents. They challenge us to make safety the first rule of life—at home, on the streets, on our jobs.

"Ninety-one pairs of Empty Shoes tell us to keep our own shoes filled!"

That was the story—in picture and in word—as it presented itself to readers of the Akron Beacon Journal last January. The story behind the story is equally interesting. And it serves to bring out my point that the first ingredient of effective evangelism for safety is zeal.

Beacon Journal librarians had taken pains through the year to maintain a card file of all traffic fatalities in Akron and Summit County. The cards showed the date of the fatality, the name, age and address of the victim and the circumstances surrounding the accident.

At the end of the year there was a check of the cards for classification of the victims into age groups, sex, occupation and the like.

Next came a visit to the Salvation Army by two of the Beacon Journal's photographers for a selection of used shoes which would fit the description of the victims—young, old, rich, poor, an appropriate pair of shoes for each victim.

After considerable experimentation to determine the most effective arrangement of the shoes, there was the actual picture-taking. And at this point I'm letting Tom Horner of the Beacon Journal staff speak for himself:

"A layout artist made the shoes up into strips. The editorial, with the help of the file cards from the library, more or less wrote itself.

"We believe, from the reaction to the page, that it was the one most effective safety piece we have ever produced."

"Here in Akron," Mr. Horner concluded, "we're expected to come up with an equally effective idea for next January. Any suggestions?"

Somehow or other, I'm not much worried over Mr. Horner and his concern about next year. My guess is that there will be a worthy sequel to "Empty Shoes" and for the best of good reasons, namely, somebody on the Beacon Journal staff is giving the matter time and attention. Somebody cares!

Quite a few years ago the idea struck me that the daily toll of deaths on the highways of my home state could be dramatized through the medium of a daily flag on our front page—a black flag if there had been a death, a white flag if there had been no death and a line underneath in either case comparing the day's death toll with a year ago.

A surprisingly large number of readers have

taken the trouble to let me know that this daily "barometer" is the first thing they look for after scanning the bannerline of our paper—even before they read my editorials!

My point is that this effective safety feature came about for no other reason than that I as an editor was sold on safety enough to look for something to make our readers more safety-conscious. Somebody cared!

This, I hope, will explain why in this essay I haven't tried to spell out the precise steps and methods by which a newspaper or radio can make itself felt in safety. My reasoning is that given a zealous desire to do this, the newspaper or radio or other medium of communication will evolve its own method just as the Akron Beacon Journal did.

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Perhaps I should pause here to point out that not all of the fruits of this journalistic concern over promoting safety are of the "gimmick" nature such as the two I've cited. That concern can manifest itself in the presentation of a genuine challenge to the intellectual prowess of the public. Long ago I discovered that readers and radio listeners like to be partners in the matter and often they come up with some amazingly excellent ideas of their own.

Every now and then I like to re-examine the time-honored assumptions of safety, even some of those which have entrenched themselves as truisms, axioms or dogmas. Sometimes I get set back on my heels for my brashness, but it's still fun.

A few months ago I teed off on the practice of all bus drivers and quite a few truck drivers of coming to a stop at every railroad crossing—including abandoned spurs. I raised the question whether the problem this procedure created for other vehicles on the highway wasn't actually greater than any problem it solved.

In conjunction with this I called for a critical review of the law requiring oncoming motorists, as well as those moving the same direction, to stop when a school bus halts on a highway. It was my own testimony that the closest calls I've ever had as a driver were attributable to those two practices. They constitute a hand-engraved invitation to telescoping crashes, and particularly if the road surface is even slightly slippery.

The requirement that opposing traffic halt when the school bus flag goes out is based on an assumption that children dismounting from the vehicle may cross the other traffic lane in front of a car. The question arises: Isn't that sheltering them too much against the realities of traffic they are going to encounter on their own the remainder of their lives?

And, in passing, isn't that a warranted criticism of school patrol methods in general? Don't they sometimes tend to stifle self-reliance?

The very fact that these questions are raised has the effect of drawing attention to existing laws and safety rules. Interest is stimulated in the safety subject. Then too, readers find it a pleasant change to be ASKED rather than TOLD.

To engender a really spirited discussion, I occasionally ask my readers if they know of any good reason for not making universal use of scientific tests for intoxication. In candor, I must report that up to now, none has come up with anything even mildly convincing on that point.

There are, as everybody knows, at least three methods for a reliable assay of that time-honored alibi: "Honest, Judge, all I had was three short beers." So I ask you what I've asked my readers many times: "Why have we been so reluctant to make use of our scientific tool in this field?"

By what seems to me to be a monstrous distortion of logic, the idea has gained acceptance that the scientific test for intoxication is a violation of the rule of law that an individual can't be made to testify against himself.

In what essential way, I ask my readers or listeners—and you may answer if you wish—does such a test for intoxication differ from the universally employed fingerprint system in crime detection?

Another point passed over lightly by opponents of the scientific tests for intoxication is that they can be used to prove the innocence as well as the guilt of the accused. They never give false testimony. They never lie.

Intoximeters have been used in some states to reduce substantially the mishaps chargeable to drivers or pedestrians who have been drinking. Alcohol figures in approximately 20% of all fatal traffic accidents on the basis of reports available. But as a newspaper editor, I have reasons to believe that figure much too low. If the alcohol angle isn't quite obvious and provable, it just doesn't get mentioned. We don't like libel suits!

Why, I keep inquiring, in the face of the demonstrated effectiveness in SOME states has there been a reluctance to use the scientific tests in ALL states?

Moving on to another question which I ask far more often than I answer:

"Why haven't railroads long before now provided either reflector buttons or luminous paint for every freight car in service?" (A tiny strip of Scotch-lite tape might even do the job.)

Until this is done, can it be said our railroads are making their maximum contribution to the traffic safety cause?

These questions and many others of like character, I've discovered, have the effect of pushing safety to the forefront of our readers' thought processes.

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As a corollary to my basic belief that the hope of safety, especially traffic safety, lies more in OBSERVANCE than in ENFORCEMENT, I've long contended that all restraints on the individual motorist or pedestrian should have about them a high degree of PLAUSIBILITY.

There's some fundamental and deep-reaching psychology involved in this contention. And in support of it, I'm more adept at asking questions than at answering them.

In order to enhance the sacredness of the word

STOP, and keep it from meaning "SLOW UP A TINY BIT," shouldn't there be developed some kind of intermediate restraining sign which would put full responsibility on those approaching it without requiring the full stop?

In other words, are those signs which so frequently seem to affront the individual's sense of reasonableness—more honored in breach than in observance—helping the total cause of safety?

Aren't those charged with responsibility forgetting that the primary purpose of traffic rules and regualtions is to MOVE TRAFFIC—not to SLOW IT DOWN?

Aren't some of our methods for achieving safety in conflict with that over-all purpose, and coming out second best for that very reason?

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I've made reference to the help an editor can get from readers in raising questions that lead to serious thinking on the safety subject. One of these comes to mind. It reached me several years ago from a railroad engineer and he's repeated it several times. He's persistent—because he feels so deeply about the matter:

"Why should business houses (and he never fails to particularize as to taverns) be permitted to expose red neon signs and detract from the effectiveness of red as a danger signal?"

"If you safety fellows want to do something to help us railroaders," he always adds, "you'll get those red signs eliminated except in places where they mean danger."

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In all of this I've intended to point up the fact that the reading public likes to be challenged and invited to contribute its nickel's worth in establishing the policies and principles basic to safety.

The average person, I've discovered, responds much better when he is APPEALED TO or CONSULTED than he does when he's PREACHED AT. About the choicest compliment you can pay anybody is to observe that he has a way of providing leadership from behind. That concept is basic in my whole approach to the public information role in safety. Let it not be MY program, not YOUR program, but OURS.

This could be referred to as the "partnership ideal" and it gears into my conclusion long ago arrived at that for anything like a complete solution of the safety problem in any community, there must be a FRONTAL ATTACK.

It can't be done casually; it can't be done by indirection; it can't be done by mere admonition.

As many as 15 years ago a Globe-Gazette editorial enunciating this principle won for us the top national C.I.T. award. And my belief in it has grown with the years.

What I'm trying to say here is that any community which does not have an integrated safety program, under the guidance of a safety council specifically set up for that and no other purpose, just isn't putting its best foot forward in the fight against accidents.

It's a claim that can be proved affirmatively or negatively. Take your choice. It's borne out by the good results achieved in those communities which have an active safety council and it's just as clearly borne out by the bad results in those communities proceeding on a "b'guess-and-b'gosh" basis.

Such a broad concept of the accident-prevention task lends itself ideally to promotion by newspapers, magazines, radio, TV, the movie screen and outdoor advertising. Through each it's easy to stress the fact that safety is a partnership proposition. Everybody can be given that satisfying sense of belonging to a cause which transcends self.

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By a somewhat circuitous route we've returned now to my starting thesis, namely, that nine out of ten Americans must be made to give safety a primacy in their thoughts and behavior and that the safety movement has greater need for evangelists than for technicians.

It isn't additional knowledge that we require, I reiterate: it's a spur and a burr to make us apply what we already know.

The status of the average American today isn't so different from that of the forthright old Iowa farmer who objected to being exposed to improved methods in agriculture, via our college extension service.

"Shucks," he protested, "I'm not farming half as well as I already know how."

The task of this evangelism is to place it upon the heart of every American that failure to accept personal responsibility in the cause of traffic safety means to fall short of the minimum standards of good citizenship.

Along with the accent on that oft-repeated and effective slogan, "The life I save may be my own," there must be a like, and even greater, emphasis, on that core of the Christian ethic: "I AM MY BROTHER'S KEEPER!"

Never in my three decades of contact with the safety movement have I been more deeply persuaded than I am at this very moment that we, the people, are going to get exactly the degree of safety we DESERVE AND DEMAND on our highways, in our homes and at our work.

I reject as a canard on the intelligence which distinguishes man from other animals that assumption of the apostles of gloom among us that the present toll of death and maiming on our streets and highways is an inescapable price of progress. Mankind's ascent up the ladder of civilization has not stemmed from any such melancholy theory.

There's a brighter day ahead in the field of traffic safety and those of us engaged in talking to our neighbors through the several media of public information can help hasten the noontide sun of that new and happier day.

Meeting Contrasts Design Ideas for Supersonic Craft

AN AIR of confidence pervaded the Hoted Statler in Los Angeles as 2200 engineers gathered there September 29–October 3 for the SAE National Aeronautic Meeting. The confidence reflected progress in the state of the engineers' arts and attainment in the art of staging meetings.

Throughout the nine Production Forum clinics, production men took for granted that techniques for building the new crop of aircraft are available and they concentrated on how to do the job more economically. During the three days of technical sessions, designers assured each other that just as they are dispelling the once-feared "sonic barrier" with sleeker planforms and more powerful engines they can clear away the "thermal barrier."

SAE members responsible for the planning of the meeting were assured, just as soon as registration began on Tuesday morning, that they were giving West Coast aircraft engineers the kind of meeting they want. Each of the all-day Production Forum panels drew a sizable audience of men eager to find answers to their own pressing problems and to help with their colleagues' problems.

The only complaint heard was that panel participants couldn't be in two places at once. (This difficulty the Society will alleviate by making available about December 1 all the panel secretaries' reports in one special publication, SP-304.)

Those attending the nine open technical sessions held for the presentation of technical papers showed the same enthusiasm. (A tenth session, because of the confidential nature of the information presented, was restricted to SAE members and government employees who had proved "need to know" to the satisfaction of the military authorities.) Nonconfidential shop talk begun in session rooms continued at Engineering Display booths, committee luncheons, and even at the board showing the boxscore of the World Series games then in progress. Everywhere technical interests brought together old friends and served to introduce new ones.

So general was the feeling of good fellowship that —although many from other parts of the country had to leave by the end of the last session on Saturday morning—800 meeting participants and their guests were on hand for the dinner-dance which capped the meeting that evening.

Adherents of different design philosophies had confidence in different solutions to the two problems which seemed to create the most interest at the sessions: (1) planform and powerplant for high-speed, high-altitude aircraft, and (2) cooling of such aircraft.

Straight Wings Versus Deltas

In the controversy over the best planform for supersonic aircraft, those advocating straight wings criticized delta wings mainly for their low maximum lift coefficients and consequent long landing and take-off runs. The straight wing, they claimed, is much better for obtaining optimum usable lift. Leading edge devices are effective, as well as trailing edge lift flaps. For a given wing area, more wing is outside the fuselage to develop lift and to

be affected by lift devices. Besides, the straight wing's shorter aerodynamic chord reduces the down tail load required to trim.

The straight-wing school admitted, however, that it must learn more about aeroelasticity in order to preclude flutter.

Delta-wing proponents retorted that the delta has far better torsional rigidity and more room for fuel and landing gear than the straight wing. The greater wing areas that compensate for the delta's lower lift coefficient contribute to higher ceilings and greater maneuverability, as well as to volume. If there's enough thrust available in a delta-wing plane for high-speed altitude flight, there's enough to get it off the ground in a reasonably short run, it was asserted.

A stress analyst brought out, incidentally, that electronic analogs pay off handsomely in the extensive study of delta wings.

Disagreements over vertical tail area requirements, lift/drag characteristics, and maximum practical ground angle of deltas weren't settled. They couldn't be because disputants' arguments were based largely on achievements covered by security restrictions. It was possible to infer, however, that the differences in design philosophies stem partly from differences in the altitude and supersonic speed regimes for which the disputants had been designing.

Little was heard in favor of the swept-wing planform. It was debited with the disadvantages of low maximum lift coefficient, like the delta, without the delta's rigidity.

Rockets or Air Breathers

Engineers are becoming more and more certain that they can do better with air-breathing engines than with rockets in certain very high-speed aircraft, sessions showed. They feel that extremely high propellant consumption rules rockets out of practically all vehicles large enough to be manned. Even for multistage missiles the ramjet may be better than the rocket as the first stage, it was suggested, because the ramjet doesn't carry the weight of its oxidizer.

In discussing planforms and powerplants, engineers talked freely of planning now for speeds of Mach 1.0 to 3.0. They showed little doubt that they had the basic knowledge on which to proceed with designs aimed at speeds well into the supersonic range.

Keeping Cool at - 67 F

When they devise the airframes and engines for these fast craft, engineers expect to be able to send them into the rarified air of 40,000-70,000 ft and higher altitudes and still keep metal and men operating efficiently.

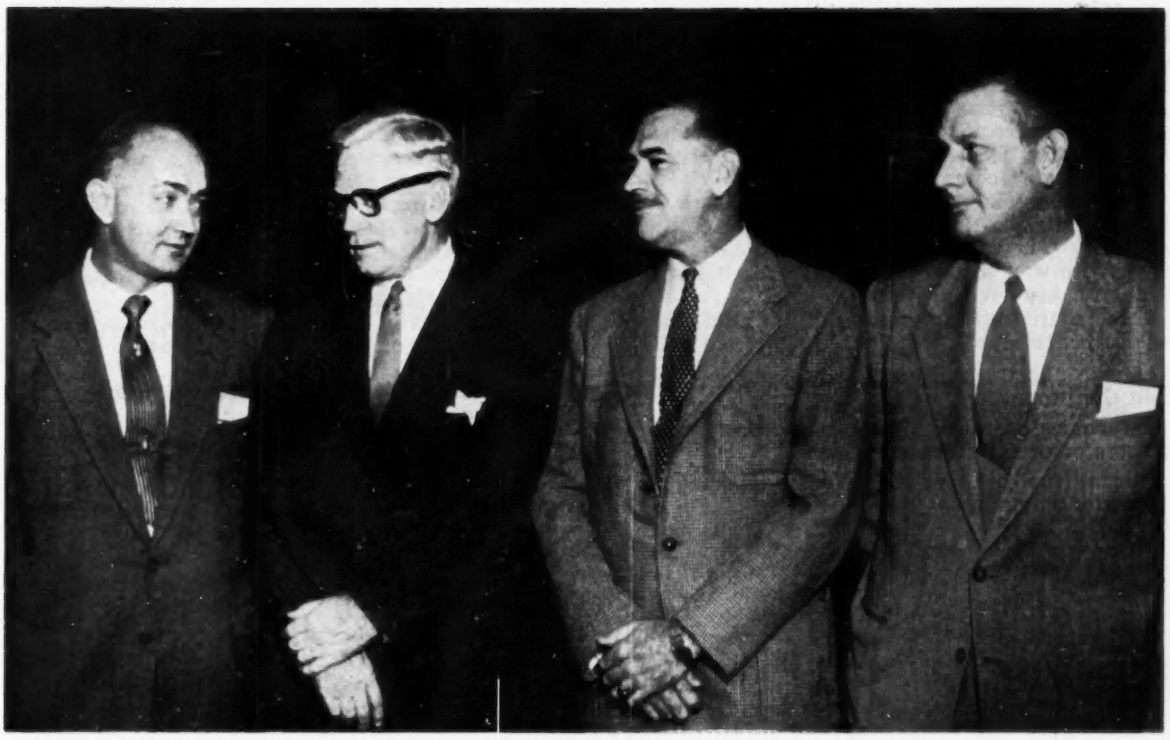
Although ambient temperature is only - 67 at 40,000 ft, heat is the big concern. It comes from (1) aerodynamic friction, (2) engines, and (3) accessories like electronic equipment—of which there will be much in military aircraft. Improved materials are counted on largely to take care of the first two items. But engineers realize they must develop new cooling systems to protect accessories. They devoted much of the meeting to that topic and to the related subject of powering the accessories.

The chief problem is, they explained, that you have to generate a lot of power to run the electronic gadgets, then most of the power is wasted in the form of heat. Despite low outside air temperatures, the heat is hard to get rid of because the ambient air is too thin at high altitudes to carry it off. It's

Meeting Planners

Four of the men who helped make the meeting so successful were Southern California Section Chairman J. O. Findeisen, Jr., San Diego Section Chairman P. L. Ward, Aircraft Activity Meetings Vice-Chairman J. D. Redding, and Aircraft Powerplant Meetings Vice-Chairman F. E. Carroll, Jr.

West Coast Men with President Cass



The Aeronautic Meeting's General Chairman F. O. Hosterman and SAE President Robert Cass line up with B. A. Willsey and B. C. Monesmith. Willsey and Monesmith were, respectively, chairman and sponsor of the Aircraft Production Forum which comprised the first two days of the meeting

SAE Vice-Presidents

SAE vice-presidents for the three activities sponsoring the Aeronautic Meeting exchange pleasantries on its success. They are (left to right) T. T. Neill, vice-president for the Aircraft Activity; O. E. Kirchner, vice-president for the Air Transport Activity; and E. G. Haven, vice-president for the Aircraft Powerplant Activity

necessary to force air or some other cooling medium around the equipment.

Several possible cooling methods were described. In one, compressor bleed air gives up some of its heat to ram air in passing through a heat exchanger and cools further during expansion through a turbine. Then part of the flow serves to cool and pressurize the cockpit, and finally it and the flow bypassing the cockpit goes on to cool accessories and the engine compartment.

Another system proposed for cases where such air-cycle refrigeration is inadequate uses fuel as a heat sink. The cooling air gives up its heat to the fuel on its way to the engine as both fluids flow through a heat exchanger.

Three sources of power for running and cooling accessories received attention:

1. hydraulic transmissions taking power directly from the propulsion engines.

2. turbines operating on air bled from the compressors of propulsion engines.

3. small fuel-burning gas turbines separate from propulsion engines.

Equipment is available for all three methods. The sense of the meeting seemed to be that no one method is best for all applications but that the turbines have the edge so far.

Technical sessions did, of course, cover many subjects besides configuration and accessories for supersonic aircraft.

The three papers presented at the closed, confidential session were:

"New Developments in Carrier Landing Techniques" by Capt. Harry Sosnoski of the Naval Special Devices Center.

"Why Hydro-Skis?" by F. H. Sharp of Consolidated Vultee Aircraft Corp.

"Development of the High-Speed Aerial Drone" by Bruce Smith of Ryan Aeronautical Co.

Highlights from all 27 of the papers presented in open sessions appear below and on the following pages. The papers are available in full in preprint form from the SAE Special Publications Department, and each will be treated in more or less abridged form in future issues of SAE Journal.

Highlights from the Papers

Fatigue Stresses

E. H. Spaulding, Lockheed Aircraft Corp., *"Design for Fatigue":*

Today's aircraft are vulnerable to fatigue because the design stresses are higher than they were in the past and because the aircraft are expected to operate longer. The newer aluminum alloys offer increased static strength but not increased fatigue strength. If designers ask more from the new materials, operators will encounter more fatigue problems.

From the fatigue standpoint, the best structure is one in which a fatigue crack can progress to a considerable extent and be found in routine inspection before causing a serious reduction in static strength. Concentrating most of the tension material in heavy spar caps is poor practice because small cracks are hard to detect. Skin-stringer construction with smaller spar caps is better.

Structures Simulator

H. U. Schuerch, Aerophysics Development Corp., *"Delta Wing Design Analysis":*

With delta wings, even thin ones of 3–4% thickness/chord ratio, the large chordwise extensions lead to fairly thick roots. Besides, the short span keeps root bending moments down. Consequently, a structural layout of the "egg crate" type is more attractive than a thick-shell monococque design.

For the design analysis of the egg-crate delta, an electrical simulator is superior to hand calculation by the wide-beam formula method or the elastic coefficient method and to model testing. The simulator is more flexible, faster, and—if many cases are to be investigated—cheaper.

Hot Structures

E. H. LaBombard, Douglas Aircraft Co., Inc., *"The Effect of Temperature on Aircraft Structural Design":*

Our biggest problem in the future may be associated with increasing endurance at temperatures in the 250–750 F range rather than with raising peak transient high-speed temperatures to 1000 F or higher. A transport flying at 300 F for 8 hr every day presents more of a problem than a missile flying once at 1000 F for 2 sec.

Maneuverability

B. G. Peterson, North American Aviation, Inc., *"Design Considerations for Maneuverability of High Speed Airplanes":*

In combat between airplanes of almost equal speed and thrust, the airplane with the lesser drag due to lift possesses a considerable advantage. This advantage shows up in tighter turns at constant altitude and shallower dives for turns of comparable radius.

Unfortunately, the wing geometry favoring high speed does not result in low drag due to lift. Therefore, there must be a compromise between highest straightaway speed and lowest speed loss in turns.

Meteorite Protection

A. M. Mayo, Douglas Aircraft Co.,

Inc., *"Taking Man to Higher Altitude"!:*

It's probable that a high-altitude aircraft presenting approximately 1000 sq ft of area projected normal to the earth might fly for 100 years before having its $\frac{3}{8}$ in. simple dural skin penetrated by a meteor. That's because the vast majority of meteors are extremely small.

If aircraft were designed with a thin outer skin and a thicker layer underneath, meteors encountered would tend to explode on hitting the outer skin into smaller particles that would not damage the under layer.

Ramjet-Assisted Rockets

J. W. Luecht, Chrysler Corp., *"Some Factors Pertaining to the Use of Air-Breathing Propulsion for the Acceleration of High-Altitude Sounding Rockets and Other Long-Range Ballistic Missiles":*

Air-breathing propulsion devices, such as ramjets, applied as the initial stage of rockets would make it possible to use considerably more of the initial gross weight for payload. This is so because near the earth, a rocket consumes about five times as much propellant by weight as does a ramjet, which takes in oxygen as it goes along.

Congratulations

Wendell E. Eldred, Consolidated Vultee Aircraft Corp., *"Landing Gear Design as Applied to Modern Aircraft":*

I congratulate the Air Force and the Corps of Engineers for their excellent work leading to the publication of the Unit Construction Index Chart for Ground Flotation Evaluation.

The chart is a valuable tool for optimizing the wheel and tire arrangement for the combined requirements of aircraft and runway. Besides, it saves a lot of argument.

High-Tensile Steels

G. E. Beringer, Bendix Aviation Corp., *"Manufacturing Requirements*

Session chairmen and secretaries for the Aeronautic Meeting were:

	Chairmen	Secretaries
Thursday morning		
	L. P. Spalding, North American Aviation, Inc.	**D. E. Dawson,** North American Aviation, Inc.
	R. W. Thaw, Douglas Aircraft Co., Inc.	**R. W. Goedhart,** Douglas Aircraft Co., Inc.
Thursday afternoon		
	J. I. Hamilton, Menasco Mfg. Co.	**W. H. Clark,** Lockheed Aircraft Corp.
	J. B. Pitkin, Lockheed Aircraft Corp.	**P. H. Jones,** North American Aviation, Inc.
Thursday evening		
	J. B. Wassall, Lockheed Aircraft Corp.	
Friday morning		
	G. W. Newton, ARO, Inc.	**Harold Hayden,** Boeing Airplane Co.
	T. R. Thoren, Thompson Products, Inc.	**E. R. Schuberth,** Lockheed Aircraft Corp.
Friday afternoon		
	W. R. Ramsaur, AiResearch Mfg. Co.	**H. J. Wood,** AiResearch Mfg. Co.
	W. W. Davies, United Airlines, Inc.	**R. L. McBrien,** United Airlines, Inc.
Friday evening		
	Edgar Schmued, Northrop Aircraft, Inc.	**R. P. Jackson,** Northrop Aircraft, Inc.
Saturday morning		
	W. C. Heath, Solar Aircraft Co.	**W. W. Withee,** Consolidated Vultee Aircraft Corp.

Guests from Other Organizations

Representing two of the organizations cooperating with SAE on the Aeronautic Meeting were Harrison A. Holzapfel (left) of the Air Transport Association of America and Capt. L. D. Webb (center) of the Aircraft Industries Association of America, Inc. Here they chat with E. W. Robischon of the staff of the Institute of the Aeronautical Sciences

Manly Medalists

Bruce Miller (left) and Robert Gorton received the certificates and medals of the Manly Memorial Award from E. G. Haven, chairman of the Manly Memorial Board of Award at the Friday evening session. Recipients were honored for their paper "Instrumentation for Aircraft Gas Turbine Development"

for Producing the Modern Landing Gear":

Steels of 250,000–300,000 psi tensile strength may go into major strut components of future landing gear. They will probably be salt-bath martempered. In this process, the part is austenitized in salt, then transferred to a salt quench which is maintained slightly above the temperature at which martensite begins to form. The part remains in the quench until it reaches an apparent temperature equilibrium. Then it is aircooled.

Brazing

G. D. Cremer, F. J. Filippi, and R. S. Mueller, Solar Aircraft Co., *"High Temperature Brazing Applications":*

An extension of infiltration-brazing techniques may provide us with superior turbine blades. In experimental development work, powdered titanium carbide has been formed into a porous skeleton blade. Then the skeleton has been infiltrated with molten Vitallium, Hastelloy C, Nichrome V, or Inconel—all of which work well. Photomicrographs show that the super-alloy phase securely brazes the refractory titanium carbide particles.

Tanker Pumps

T. R. Farrington, Wright Air Development Center, *"Tanker Aircraft Refueling Systems":*

Present design studies indicate that tanker aircraft with more than one refueling connection may make optimum use of a series pumping arrangement. The idea is that tank-mounted pumps with low discharge pressures would supply fuel to a manifold line. Line-mounted pumps at the inlet to each refueling reel or boom would supply proper pressure at the inlet to the refueling coupling.

Fuel Rating

Com. D. L. Nowell, Navy Bureau of Aeronautics, *"The Armed Services-Industry Cooperative Study of Aircraft Fuel Rating Methods":*

As the result of an Armed Services-Industry study project, we can now reschedule engine power settings intelligently any time that an excess of aviation gasoline volume requirements over alkylate production ability requires use of substitute fuels.

Data collected by the study group have been consolidated into a series of charts relating the knock-limited performance of aircraft engines with the laboratory test characteristics of the fuel.

Why Complexity?

R. R. Higginbotham and W. R. Petersen, Republic Aviation Corp., *"Fuel System Complexity—How Much Is Necessary?":*

Here's an example of one kind of deterrent to simplification: Operating units requested a deletion of certain equipment. But the deletion could not be approved by Procurement because of a directive from Military Requirements. And Military Requirements could not change the directive because the item had been demanded by the operating units. Once a requirement is on the books, it is likely to remain there long after it has outlived its usefulness.

Bang!

W. K. Klose, Boeing Airplane Co., *"A New Concept of Explosion Testing of Aircraft Equipment":*

A fuel boost pump, under test for compliance with the Air Force Procedure II Explosion Proof Test, unexpectedly ignited the external explosive mixture. But it won't happen in flight. Because of this one explosion, Boeing initiated studies which turned up much new knowledge on explosion propagation. What's more, the company developed a new test, much more revealing than the usual procedures.

Cooling Equipment

Doyle C. Wells, Ryan Aeronautical Co., *"Cooling Electric Equipment During Supersonic Flight":*

At supersonic speeds and altitudes over 15 miles, not only electronic equipment but also hydraulic and electrical systems will need cooling other than air cooling. Fuel will probably be the best choice for an integrated aircraft cooling system heat sink. However, liquid evaporation may be better for some small isolated pieces of equipment.

Fuel rate for a jet engine of 10,000 lb thrust is about 30 gpm at cruising. This could dissipate 50–75 kw of heat—more than ample for any electronics combination in current aircraft.

Flight-Test Measurements

W. L. Howland, Lockheed Aircraft Corp., *"Flight Test Instrumentation Status":*

Almost 900 different quantities were measured and recorded automatically during flight tests of the Constitution. Of these, 218 were recorded photographically, and 208 were recorded on tape-type recorders. Also, 422 temperatures were recorded automatically. That gives you an idea of the complexity of flight-test instrumentation for modern aircraft.

Ramjet Controls

J. C. Wise, Marquardt Aircraft Co., *"Holding the Reins on 300,000 Horsepower":*

Analysis of a hypothetical ramjet at (1) 10,000 ft, Mach 3, and maximum thrust and at (2) 80,000 ft, Mach 3, and level cruise thrust, shows the extent of the control problem. Power varies from 370,000 to 2000 hp. Fuel flow varies from 45 to 0.27 lb per sec. Stagnation air temperature goes from 1100 to 780 F. Stagnation air pressure, which is the pressure surrounding the metering equipment, varies from 260 to 10.5 psia.

High-Speed Props

W. H. Clark and Joern Schmey, Curtiss-Wright Corp., *"Control Systems and Noise Problems for High Speed Propellers":*

With propeller-driven supersonic aircraft, there will be no propeller control problems beyond those already encountered in

present turboprop propellers at transonic and lower airspeeds.

Turboprop planes will be no noisier than current airliners to those on the ground, except in areas within a few thousand feet of the take-off runway.

Turbines' Success

H. J. Wood, AiResearch Mfg. Co., *"Has the Teapot Tempest Come of Age?":*

The small gas turbine will find its market wherever its favorable weight ratio counts more than its higher fuel consumption.

We believe that in three years the gas turbine will be able to compete costwise with piston engines in equal production quantities.

Overhaul life between 500 and 1000 hr is well within our grasp for airborne equipment. Longer overhaul intervals are possible at some weight penalty.

New Heat Source

G. A. Lemke, Consolidated Vultee Aircraft Corp., *"Pressurizing and Air Conditioning a Fighter Airplane—Design Problems and Compromises":*

Cooling requirements for the electronic gear on a supersonic fighter are about four times that of the cockpit. Therefore, the requirements of the electronic equipment establish the type of cooling to be used.

The current trend is toward air-cycle refrigeration.

Novel Turbine

L. W. Biwer and R. L. McManus, General Electric Co., *"Small Turbines—The Heart of Modern Aircraft Accessory Power Systems":*

An air turbine powering an afterburner fuel pump has an unusual overspeed-prevention device: As the turbine reaches overspeed, the efficiency falls off rapidly and the main stage chokes. At this point, the air tends to flow around the outside of the shroud. Small tangs on the outside of the shroud, which reverse the force direction from that of the main stage buckets, catch the airflow and brake the turbine.

Hydraulic Transmissions

C. L. Sadler, Sundstrand Machine Tool Co., *"Hydraulic Power Transmission for Accessory Drives":*

Altitude operation presents no problem to a hydraulic transmission. The working circuit is completely independent of ambient pressures. This means that as much power can be delivered by the hydraulic transmission at extreme altitudes as on the ground —a feature not readily attainable in most other types of transmissions.

Gust Loads

T. L. Coleman and Roy Steiner, National Advisory Committee for Aeronautics, *"Some Trends in Gust Loads for Transport Airplane Operations":*

Thanks largely to increased wing loading and higher operating altitudes, riding discomfort due to gusts has decreased over the last 20 years. But gust loads have increased slightly because airplanes have tended to fly during more severe turbulence.

Estimates of gust loads on future jet transports indicate that benefits derived from higher altitude operations may be offset by loads encountered during faster climbs and descents.

Figuring Fuel

K. G. Wilkinson and J. Vivian, British European Airways, *"A Rationalised Fuel Reserve Policy for Medium Range Airline Operations":*

British European Airways is applying probability techniques to the determination of fuel quantities required for safe and regular operation and of the payload to be sold. The risk level used is, of course, very conservative.

Chief benefit is the added payload available under circumstances where the fuel reserves carried are less than they would have been under the old fuel policy.

Total Transportation

C. M. Belinn, Los Angeles Airways, Inc., *"Helicopter Passenger Progress":*

Only the helicopter is capable of "total transportation." It is sure to play an important role in the future.

The one question facing air transport operators now is whether to plunge into the game with present equipment or to wait until more economic equipment is ready.

Straight Wing vs. Delta

C. L. Johnson, Lockheed Aircraft Corp., *"Airplane Configurations for High Speed Flight":*

Thin, unswept wings are generally superior to deltas for supersonic flight. Chief drawback of the delta is its low maximum lift coefficient. This factor largely counteracts the delta's low wing loading.

Lockheed tests show the straight-wing aircraft with proper tail design to have considerably better stability and control characteristics than delta-wing aircraft.

Sanding Runways

L. A. Johnson, Minneapolis-Saint Paul International Airport, *"Snow Removal and Ice Control":*

At Wold-Chamberlain Field we use a weed burner to burn sand into icy runways. Trucks mounting mechanical spreaders strew the sand. Weed burners follow right behind, melting the sand into the ice to make a sandpaper-like surface that gives excellent traction.

Hot Table Tops

Squadron Leader C. R. Thompson, Royal Canadian Air Force, *"Cold Weather Operation of Aircraft":*

To educate the crew to wear clothing suitable for survival in case of a crash, we restrict cockpit temperatures in Arctic aircraft to 0–5 C. Then so that the navigator will be comfortable in his clothing, yet nimble-fingered for plotting, we heat his table top. The heaters for this purpose dissipate power at 55 or 75 w per sq ft.

Aeroproducts-Allison Division, General Motors Corp.

Aeroquip Corp.

AiResearch Mfg. Co.

Bendix Products Division, Bendix Aviation Corp.

Bridgeport Thermostat Division, Robertshaw-Fulton Controls Co.

C & H Supply Co.

The Cleveland Pneumatic Tool Co.

Encyclopaedia Brittanica, Inc.

The Franklin C. Wolfe Co.

General Controls Co.

Hamilton Standard Division, United Aircraft Corp.

Hi-Shear Rivet Tool Co.

Hydro-Aire, Inc.

Lear, Inc.

Lord Mfg. Co.

New York Air Brake Co.

Pacific Airmotive Corp.

Pacific Scientific Co.

Rod Bank Division, Bendix Aviation Corp.

Resistoflex Corp.

Rosan, Inc.

Ryan Aeronautical Co.

Scintilla Magneto Division, Bendix Aviation Corp.

Solar Aircraft Co.

Stratos Division, Fairchild Engine and Airplane Corp.

Sun Electric Corp.

Surprenant Mfg. Co. (Airsupply Co.)

Titeflex, Inc.

United States Steel Corp.

Vickers, Inc.

Western Gear Works

Westinghouse Electric Corp.

Enlarged Display Area Accommodates More Exhibits Than Ever Before at West Coast Aero Meeting

Panels Provide Answers

Materials Handling

Forming

Procurement

Change Control

for 1100 Production Men

Control of Manufacturing Costs

Economics of Tooling

Quality Control

Plant Layout and Plant Engineering

Machining

Tractor Meeting Strives to

TRACTOR and implement engineers are just as enthusiastic about—and concerned with the standing of—their creations as Milwaukee baseball fans are about their Braves! What better proof of this need be offered than the fact that they, too, smashed an all-time attendance record for a Milwaukee event—the SAE National Tractor Meeting. Over 1240 tractor and implement design engineers and production men jammed into the Schroeder Hotel, Sept. 14–17, for this biggest of all Milwaukee Tractor Meetings and Production Forums. They came in droves to share the latest information on:

- How to produce finicky tractor and implement parts.
- Why tractor hitch dimensions need to be standardized . . . and what this would involve.
- What an SAE technical committee has done to promote safe lighting of tractor-drawn implements on the highway.
- Ways tractors are tested.
- How to steer a laterally rigid all-wheel drive wheeled tractor.

Emphasizing the need for keeping production costs down, Society President Robert Cass scored SAE Production Forums as being just what the doctor ordered. They're helping to prove that there's no production problem that can't be solved together, he told the over 300 people at the banif design and production engineers put their heads quet. But we still have got to solve the human side of our production problem, Cass warned. Also, engineers are going to have to find ways to conserve short supplies of such critical materials as copper and nickel.

Banquet speaker James E. Gheen struck a happy mixture of humor and reality with this explanation of why tractor and implement engineers thronged to this meeting: "To get something into their heads that wasn't in there before or get something out that shouldn't be there." Cautioning that nothing happens until somebody has an idea, he gave this formula for success: "You can do anything you want to do, if you just know how to do it."

Finding out how to do it was, in fact, the order of the day for the over 500 men that packed the seven all-day production forum panels. There, production engineers traded the latest information on welding, gear-making, heat-treating, machine tools and tooling, forging, production control, and quality control. (See pages 75–77.)

Other tractor and implement engineers flocked to the six technical sessions to exchange ideas on how to improve the "standing" of their products with Farmer Jones.

Tractor hitches and hydraulic systems that more nearly met field requirements would make a big hit with him, it was pointed out. Tractor hitch dimensions need to be standardized so that one make of integral implement will operate successfully with all makes and models of tractors . . . and vice versa. As for hydraulic systems, what's needed is a control that will satisfactorily operate a wide variety of implements instead of just a limited few.

Tractor and implement engineers, alike, expressed a desire to provide their machines with these features, but it's nowhere near as simple as it sounds, they agreed. For one thing, noted one tractor engineer, while the hitch and hydraulic system are but two of the many components that make up a tractor, they dictate tractor size and configuration! Consider, for example, the use of a front integral hitch. To permit an adequate stroke of front-mounted implements, the front of the tractor chassis may have to be raised as much as 10 in. This, in turn, not only introduces a stability problem, but it also presents seat-access and seating-comfort problems, he pointed out.

For reasons such as this, the tractor and implement engineers present felt that it's going to take a lot of hard work and coordinated effort to come up with a satisfactory standard or recommended practice for tractor hitches and hydraulic systems.

Farmer Jones will have to wait a while, then, for tractors that can hitch up to his various farming tools. But he doesn't have to wait any longer for safe highway lighting for his tractor and drawn implements, reported the chairman of the SAE Tractor and Implement Lighting Committee. Using a breakaway connector developed by the committee and either a bracket-mounted telescoping lamp or various types of extension-cord lamps, Farmer Jones can get the safe lighting he needs for operating on the highway at night.

Our rural friend is also assured of getting better tractors thanks to tests carried out by individual tractor manufacturers and the University of Nebraska, noted other engineers.

Make Farmer Jones Happier

For example, accelerated testing of tractors and their component parts by their makers gives designers some idea of what their creations can and can't do long before this information could be obtained from normal testing or customer usage. Thus, they are able to get the bugs out of their product before putting it in the hands of the buyer. And this means fewer aggravating, costly breakdowns in service—and far more customer satisfaction.

New makes and models of tractors also are put through their paces at the University of Nebraska, chimed in another speaker, and this, too, helps the farmer by:

1. Providing him with impartial test data on the performance of different tractor models.

2. Encouraging better design, more reliable sales information, and more effective use of tractors.

To a number of discussers, however, a definite need exists for more simplified reporting of these test results. Many prospective tractor buyers can't understand present reports thoroughly, they claimed.

Another engineer felt that if the Nebraska test program is to encourage better tractor design, then it must accurately reveal small differences in performance. He recommended, therefore, that all tractors be tested under as nearly identical atmospheric conditions as possible. For that matter, making corrections for psychrometric conditions was suggested by one discusser.

At still another session, wheeled tractors were said to have been improved for Farmer Jones by

Mission Accomplished

Happy over the success of the six technical sessions were: (left to right) SAE Tractor and Farm Machinery Meetings Vice-Chairman Merlin Hansen, SAE T&FM Vice-President C. T. O'Harrow, and General Chairman of the Meeting L. C. Evans

making them a closer kin to crawler tractors. Laterally rigid all-wheel drive 4-wheel tractors that permit taking advantage of the good drawbar pull/weight ratio of crawlers are now an accomplished fact, reported one designer. The steering problem has been licked with a special regenerative transmission that varies the relative speeds of the wheels on each side of the vehicle. This is done with a system of spur gears mounted on two main shafts that can be disengaged with clutches, he explained. No brakes are used.

To one discusser, this system of all rotating clutches with countershaft transmissions might be suitable for small, light-duty machines, but he felt that planetary arrangements would be superior for heavy-duty equipment.

(Summaries and highlights of the papers presented at the Meeting are below and on the following pages.)

Huge Mining Vehicles

E. R. Dickie, General Manager, Bagdad Copper Corp., *Larger Equipment Needed for Open Pit Mining:*

Open pit mining of the low grade ores that are of necessity being mined today calls for larger and more efficient equipment. Why? Because experience has shown that where a job warrants the use of large equipment, cost per yard of material loaded or hauled is inversely proportional to equipment capacity.

Wheel Tractor Steering

G. R. G. Gates, Managing Director, Gates and Hardy Ltd., *A Super-Regenerative Transmission for Multi-Driven Wheeled Tractors:*

Wheeled tractors have stolen some of the thunder of train locomotives and track-laying vehicles. Now they, too, can be equipped with laterally rigid all-wheel drives that permit taking advantage of the good drawbar pull/weight ratio of crawler tractors. The steering problem has been licked! A special regenerative transmission that varies the relative speeds of the wheels on each side of the tractor (slowing down the inside wheels) proved the answer.

Designing Oil Coolers

R. P. McDonough, Harrison Radiator Division, General Motors Corp., *The Development and Application of Oil Coolers for Torque Converters:*

It isn't easy to design the compact, high-performance oil coolers that torque converters require. All of these things have to be taken into consideration:

- Size of cooler required.
- Maximum oil temperatures that can be tolerated.
- Rate of oil flow.
- Rate of cooling medium flow.
- Maximum heat loss rate in the converter.

Probably the hardest job of all, however, is finding space in the engine compartment for the oil cooler once designed—no matter how small it is.

"Fast" Tests De-bug Tractors

D. R. Richardson and G. R. Fuller, Caterpillar Tractor Co., *Accelerated Testing of Tractor Components:*

Accelerated testing of tractors and their component parts has become an important part of tractor development. That's because it gives designers some idea of what their creations can and can't do long before this information could be obtained from normal testing or customer usage. In short, it's a help in getting the bugs out of a product before it is put in the hands of a customer. Accelerated testing is of no value, however, if the results are not reproducible and—except for comparative tests—if they cannot be produced by normal testing.

Tractor Lighting

B. G. Van Zee, Minneapolis-Moline Co., *Report of the Tractor & Implement Safety Lighting Program:*

Development of a standard breakaway connector for a tractor lighting system proved to be one of the easier parts of our program to provide safe lighting of tractor-drawn implements on the highway. The requirement that light be visible 500 ft to the front and to the rear—and that the general outline of the drawn implement be visible to oncoming motorists—was not so easy to solve.

"Crawlers" Take to Farms

R. O. McSherry, Allied Equipment and Sales Promotion Manager, Oliver Corp., *"Crawler" Purview in Agriculture:*

Crawler tractor population on farms has gone up 70% in the last seven years—thanks to the superior traction and flotation qualities of these workhorses. These qualities make crawlers well-suited for:

- Plowing and deep tillage.
- Transplanting work.
- All operations necessary in land clearing.
- All orchard operations.

Major disadvantages of crawler tractors are: relatively slow speeds and inability to travel on highways because of their track cleats.

Greetings!

SAE Milwaukee Section Chairman C. L. Spexarth extended an official welcome to the packed house at the Tuesday morning session

Tractors Put Through Paces

L. F. Larsen and C. W. Smith, University of Nebraska, *Tractor Testing at the University of Nebraska:*

Tractors are tested at the University of Nebraska for two reasons:

1. To provide the public with impartial test data on the performance of different tractor models.

2. To encourage better design, more reliable sales information, and more effective use of tractors.

Tillage Tool Ingredients

W. D. McMillan and W. C. Bliesener, International Harvester Co., *Tillage Tools—Material and Heat Treatment:*

It takes more than just clean SAE 1085 steel to make good harrow disks. To best insure good performance, these discs should be blanked from cross-rolled steel and heat treated to a uniform hardness throughout of 38 to 45 R_c. In short, the quality and uniformity of these and other tillage tools stem from well-controlled manufacturing practice — right through to the final grind.

Slip That Load

Fred M. Potgieter, Vice-President, Charge of Sales, Mechanics Uni-

Banquet Bound

Entertaining, yet thought-provoking, talks by this trio highlighted the Thursday night banquet: (left to right) James E. Gheen, Guest Speaker; E. F. Tomlinson, Toastmaster; SAE President Robert Cass

They Drew the Plans . . .

Committee Chairmen who did vital, behind-the-scenes work were: L. C. Evans—General Chairman; C. T. O'Harrow — Chairman, Tractor and Farm Machinery Activity Committee and Banquet Chairman; N. P. Petersen—Chairman, Production Activity Committee; N. P. Mollinger—Production Forum; F. J. Hartshorn, Jr.—Publicity and Promotion; and G. A. Rea —Reception

. . . Laid the Foundation . . .

Session Chairmen who kept things running smoothly at the six technical sessions were: R. M. Smith, Caterpillar; A. F. Meyer, Jr., Heil; W. H. Worthington, John Deere Waterloo Tractor; S. C. Heth, J. I. Case; K. W. Anderson, Deere and Co.; and W. E. Swenson, Minneapolis-Moline

. . . Added Finishing Touches to Meeting

Session Secretaries whose great work helps ensure that SAE Journal presentations of technical papers will cover all sides of all issues were: N. L. Snowden, Caterpillar; J. E. Wieschel, Heil; R. W. Hautzenroeder, Harry Ferguson; Shirley Lake, J. I. Case; C. L. Zink, Deere and Co.; and A. C. Cragg, Donaldson

Around The Meeting

Blessed Events: Norman Mollinger, of Ladish, sired two outstanding events in Milwaukee. He chairmanned the biggest SAE Production Forum yet held there. And his wife presented him with his sixth offspring and fifth daughter. . . LeTourneau's D. K. Heiple—scheduled to be chairman at Tuesday morning's session—wasn't able to make it due to inexcusable tardiness of that ol' stork.

• • •

Dieting, noted Dick Steding of Chrysler, stacks up much like Mark Twain's efforts to quit smoking. Said Twain: "I know I can do it because I've done it a thousand times before." . . . Another man at the meeting reported that the only successful way to lose weight is to stop eating the things you like!

• • •

In years gone by, all the farmer wanted was a tractor that would run, observed E. A. Hunt of Massey-Harris. The modern farmer goes to agriculture college and comes back with a smattering of engineering ignorance. As soon as he starts up his tractor and hears a slight sound from the gear box, he starts complaining he's got gear noise . . . 'cause he heard at college that's one of the problems engineers have in designing gears.

• • •

Overheard at the CIMTC Executive Committee meeting: A drunk stumbling around his hotel room fell out of the window. Immediately a crowd gathered and a policeman forced his way through the mob to the center. Said the officer to the horizontal lush, "Hey, what goes on here?" Replied the drunk, "I don't know, jus' got here myself."

• • •

Warning that accelerated tests of tractor components may or may not give the true answer, D. R. Richardson of Caterpillar cited this example: A young fellow met his date at the appointed time and place and immediately tried to kiss her. She reacted with a slap! He had made his accelerated test and gotten his answer. But was it a true answer? Had he taken his time and slipped her a kiss when he bid her goodnight, might he not have gotten far different results?

• • •

This golf story was enjoyed by many a duffer at the banquet: A minister out playing golf was having a terrible time of it. Down five holes with five left to play, he turned to his caddy and said: "We better pray on this one, Henry." Then, addressing the ball, he muffed the shot badly. "Guess we didn't pray hard enough, Henry," he said. "Well, suh, I dunno," Henry replied. "In our church we keep our heads down when we pray."

• • •

You never know who you're going to influence by what you do or don't do, noted banquet speaker James E. Gheen. To illustrate this, he told the story about the factory timekeeper who each day religiously set his watch by the clock in the jewelry store he passed—just to make sure he blew the factory whistle at the right time. One day when the timekeeper boasted to the jeweler about this, the store owner burst out laughing. "Why are you laughing," queried the factory man. "Because I set the clock by the factory whistle," chortled the jeweler.

versal Joint Division, Borg-Warner Corp., *Universal Joint Applications to Power Take-Off Drives on Farm Machinery:*

Implements with high inertia (balers and forage harvesters) can impose starting loads on power take-off shafts that are four times the average running torque. A suitable safety slip clutch in the power take-off driveline will, however, eliminate these high starting torques. Such a slip clutch need not greatly reduce the capacity of an implement. What's more, it probably will be partly paid for by the savings in cost of the driving mechanism.

Standardize That Hitch!

B. B. Johannsen, John Deere Plow Works, Deere & Co., *Tractor Hitches and Hydraulic Systems—An Implement Designer's Viewpoint:*

Integral implements have got drawn implements beat in many ways, but they'd be even better if tractor hitches and hydraulic systems more nearly met field requirements. For example, tractor hitch dimensions need to be standardized so that one make of integral implement will operate successfully with all makes and models of tractors . . . and vice versa. As for hydraulic systems, what's needed is a control that will satisfactorily operate a wide variety of implements instead of just a limited few. The only way to accomplish these ends is for tractor and implement designers to get together and discuss—then solve—their individual and mutual problems.

Tractor Hinges on Hitch!

Harold L. Brock, Ford Motor Co., *Tractor Hitches and Hydraulic Systems—A Tractor Designer's Viewpoint:*

The hitch and hydraulic system are but two of the many components that make up a tractor, *but they dictate the general design of the vehicle!* Consider, for example, the use of a front integral hitch. To permit an adequate stroke of front-mounted implements, the front of the tractor chassis may have to be raised as much as 10 in. This, in turn, not only introduces a stability problem, but it also presents seat-access and seating-comfort problems.

"Words" Parlayed into "Ways" at Tractor Production Forum

"WHAT does it take to produce finicky tractor parts?" That's what over 500 men engaged in tractor production flocked to the seven all-day production forum panels to find out . . . and they did! They parlayed these nine simple words into a textbook of valuable, down-to-earth information on:

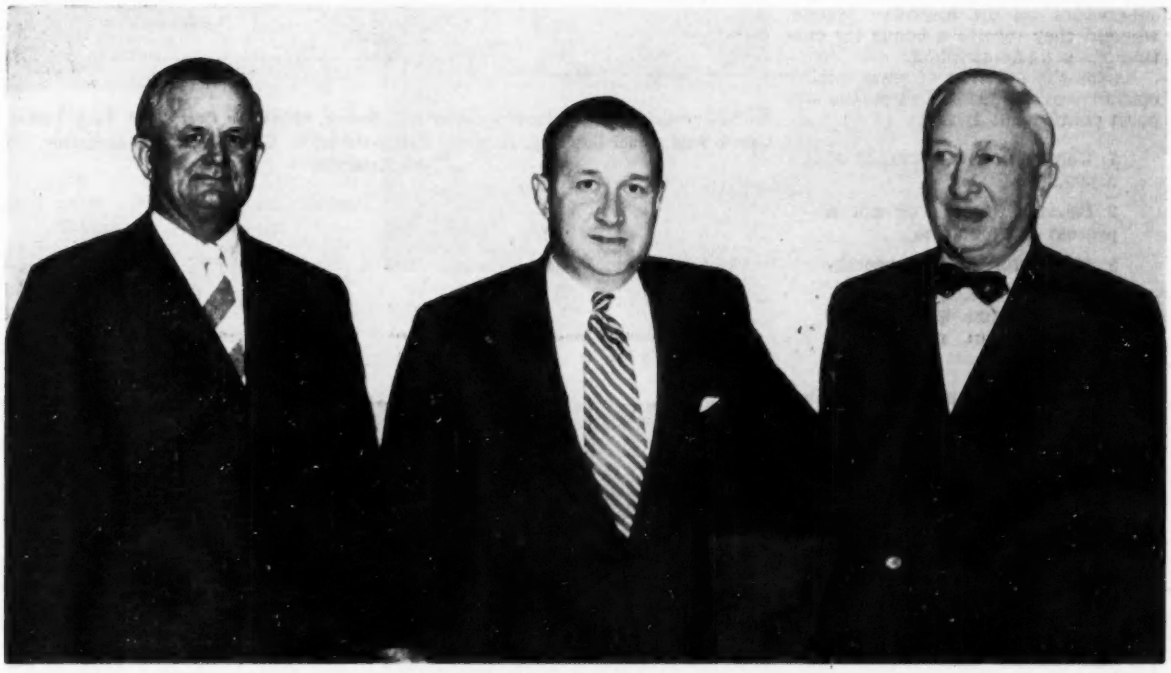
- Welding
- Gear-making
- Heat treating
- Machine tools and tooling
- Forging
- Production control
- Quality control

At the welding session, for example, they learned that perfect welds are not absolutely essential for all jobs. The relatively new method of welding steel—sigma welding—came in for mention too. With sigma welding, it's possible to deposit metal at the rate of 30 to 40 lb per hr (compared with 3 to 10 lb per hr with other methods). What's more, this method of welding can be used for nonferrous applications also, it was pointed out. Still another piece of useful information that came out at this session was the warning that the preheating temperature of cast iron prior to welding should not exceed 1200 F. If temperatures over this figure are employed, ultimate strength of the material may drop from 40,000 psi to 26,000 psi and less, one panelist advised.

Pre-treating can make a lot of difference in the distortion that occurs with gears, it was revealed at another session. To get best grain structure, the longest possible cycle should be used for normalizing and annealing. As for the question of whether or not to shotpeen gears, this rule was cited: If austenite is present in the grain structure, then shotpeening will serve a useful purpose . . . if austenite isn't present, then it won't.

The question of how to heat-treat gears was a hot one at the heat-treating panel, too. It's not a good idea to direct-quench gears when carburizing, said one specialist. Not only does direct quenching give poor grain structure, but it also doesn't permit much control of distortion. As for gears that are to be carbonitrided, the material to use is SAE 1020 steel, another expert reported. This will permit a hardness of 65 to 66 R_c to be obtained. At the forging session, the audience learned that the life of dies

It's A Hit!



Directors of the hit production—the 1953 SAE Milwaukee Production Forum—were: (left to right) W. A. Roberts, Sponsor; N. P. Mollinger, Chairman; and N. P. Petersen, SAE Production Activity Vice-President

used to forge small parts depends a whole lot on the type of heating used. By using induction heating, it's possible to get 25 to 50% longer die life than if oil heating is employed, according to one expert.

Ways to prolong the life of still another production tool—cutting tools—were outlined at the machine tools and tooling session. Use of the proper type of coolant was emphasized as one way to prolong tool life. A tapping operation, for example, calls for use of a wax coolant; a drilling operation, on the other hand, does not. The way tools are ground is all-important, too. And perhaps the only way to make certain that this is done right is to make tool grinding more attractive moneywise, said some production men. Be this as it may, the fault may well lie with machine tools themselves, others chimed in. Machines aren't built to use carbide the way it should be used. They're not sufficiently rigid, nor adequately powered . . . and these two factors can have a deleterious effect on tool life.

Enlightened in a somewhat different manner were two other panel audiences who found out what they can—and can't—expect to achieve with production control and quality control.

Production control, it was noted, should control all things which involve the final product. One of the problems it can help solve is that of scrap waste. Weekly and monthly scrap reports—and daily scrap tours by supervisors—will reveal where trouble lies. Then, knowing this, the waste problem can generally be licked by putting supervisors on an incentive system, wherein they receive a bonus for cutting scrap waste so much.

As for the question of what quality control can do for industry, the experts pointed out that it:

1. Can improve the quality of a product,
2. Reveals whether or not a process is economical,
3. Makes for realistic specifications,
4. Places blame where it belongs—on man, machine, or material.

In short, while quality control makes an excellent tool for many things, don't count on it being a cureall was the final bit of advice passed out.

These and other thoughts expressed at the seven production forum sessions will appear as feature articles in future issues of SAE Journal. The articles will be based on reports of the individual panel secretaries.

In the meantime, all these reports have been multilithographed and combined as an SAE Special Publication—SP-303. This package is available right now to SAE members for $1.50 and to nonmembers for $3.

QUALITY CONTROL—(Left to right) Ralph Brown, Minneapolis-Moline; F. Holbik, J. I. Case; Panel Secretary L. O. Laabs, Le Roi; Panel Leader R. S. Saddoris, A. O. Smith; E. Schiesel, Mattatuck Manufacturing; and C. P. Dewus, International Harvester

GEARS—(Left to right) Panel Secretary E. J. Borisch, Milwaukee Gear; F. H. Boor, Timken-Detroit Axle; Panel Leader E. A. Hunt, Massey-Harris; G. C. Collins, Clark Equipment; and C. Tohn, Caterpillar

FORGINGS—(Left to right) Panel Secretary H. Winkleman, Ladish; H. F. Wood, Wyman-Gordon; J. Dierbeck, International Harvester; Panel Leader C. E. Stone, Interstate Drop Forge; C. Olson, Fuller Manufacturing; and H. Tillson, Ladish

MACHINE TOOLS AND TOOLING—(Left to right) T. Vickers, Clark Equipment; S. Mezzio, Blackhawk Manufacturing; K. A. Powell, Minneapolis-Moline; Panel Leader G. Swardenski, Caterpillar; F. Sills, Union Carbide and Carbon; Panel Secretary D. Hopkinson, Outboard Marine and Manufacturing; and R. Niels, Allison Division, GMC (not present for picture)

HEAT TREATING—(Left to right) Panel Secretary L. Higgins, Ladish; G. B. Kiner, International Harvester; Dale Wright, Caterpillar; Panel Leader J. E. Schoen, Marquette University; J. Byerstead, Nordberg; V. Erickson, American Steel Treating; and J. F. Klement, Ampco

WELDING—(Left to right) Panel Secretary Q. Ingerson, Ampco; J. Frantzreb, J. D. Adams; Carl Zilch, Bucyrus-Erie; I. R. Bartter, Automatic Welding; Panel Leader J. J. Chyle, A. O. Smith; M. Hippe, Union Carbide and Carbon; Peter Stern, Heil; and Willard Schumbacher, Allis-Chalmers

PRODUCTION CONTROL—(Left to right) Panel Secretary W. Hoth, Outboard Marine and Manufacturing; R. F. Luckes, Chain Belt; P. A. Miller, Leece-Neville; Panel Leader J. E. Adams, White Motor; Harvey Taylor, Heil; L. Schmidt, Allis-Chalmers; and R. Wetzel, Bendix-Westinghouse; Del Hanson, J. I. Case, was not present when this picture was taken

About SAE

DR. ARTHUR NUTT, director of engineering and contracts, Bridgeport-Lycoming Division of AVCO, will continue in his present position in addition to acting as president of a newly formed company, The Quality Control Co. of Bridgeport, Conn. The new organization started to function September 1. It is doing industrial X-ray and will branch out eventually into all kinds of physical, chemical and quality control testing. Dr. Nutt was SAE President in 1940.

Nutt

Graham

HARRY J. GRAHAM, who will be vice-president and secretary of The Quality Control Co., will also continue in his present position as chief engineer at Bridgeport-Lycoming.

ERNST F. KLESSIG has been appointed director of engineering for Airway Products, Inc., Pontiac, Mich. Previously with Vickers, Inc., Detroit, Klessig designed a power steering pump now used on most automotive vehicles being built today with power steering.

Klessig

Bay

ROGER O. BAY has been elected a vice-president of the Bonney Forge & Tool Works at Allentown, Pa. He was formerly sales manager, Automotive Division, Cleveland Pneumatic Tool Co., Cleveland.

E. ZUMSTEG, formerly executive assistant, nonvehicle products, for General Motors Suisse S.A., Bienne, Switzerland, subsidiary of General Motors Overseas Operations, New York, is now director of public relations.

FREDERICK J. KNEISLER is now a test engineer for Chevrolet Motor Division, GMC, Detroit. He was assistant superintendent of the experimental laboratory, Chevrolet Aviation Engine Division, GMC.

WILLARD F. ROCKWELL has completed his third special mission for the Department of Defense as special assistant to **SECRETARY WILSON.** He has resigned his government post to return to his wide private business interests. As announced in the July issue of the Journal, he is now chairman of the Rockwell Spring and Axle Co., a consolidation of the Timken-Detroit Axle Co. and Standard Steel Spring Co.

Rockwell

Gunness

ROBERT C. GUNNESS, assistant general manager of manufacturing of Standard Oil Co. of Indiana, has been elected a director. Gunness, who joined Standard Oil in 1938, will remain in his present position.

ROLAND WHITEHURST, vice-president of The Electric Storage Battery Co., Philadelphia, manufacturer of Exide batteries, has announced receipt of a government contract in excess of $3.5 million. This contract is in addition to a $2,000,000 government contract Exide announced last August for special type batteries developed in the company's research laboratories.

DONALD J. KULLMANN is now a test engineer for the Badger Meter Mfg. Co., Milwaukee. Previously he was project engineer for Tractomotive Corp., Deerfield, Ill.

JOSEPH SHARPE is now with Consolidated Vultee Aircraft Corp., Fort Worth Division, as senior design engineer. He was liaison engineer in the Crosley Division of AVCO Mfg. Corp., Nashville, Tenn.

REX F. JEIDE has been promoted to sales manager of Minneapolis-Moline Co.'s seven-state district which includes Minnesota, northeastern Wisconsin, Iowa, North Dakota, South Dakota, Montana and Wyoming. He was previously in the industrial sales department of the company.

JOSEPH S. CARDILLO has become a design engineer with Sargent Engineering Corp., Huntington Park, Calif. He was previously with Sundstrand Machine Tool Co., Hawthorne, Calif.

MALCOLM P. FERGUSON, president of Bendix Aviation Corp., in awarding the Bendix trophy pointed out that in the 22 years since **JIMMY DOOLITTLE** became the first Bendix winner, aircraft speeds have virtually tripled. Ferguson gave the award to Maj. William T. Whisner, Jr. who flew an F-86-F Sabrejet from Edwards Air Force Base in California to the National Aircraft Show at Dayton Municipal Airport in 3 hours, 5 minutes, 45 seconds.

Ferguson

LeMay

ERNEST G. LeMAY, JR. has been named president and general manager of Century Controls Corp., Farmingdale, N. Y. LeMay, previously project engineer (controls) for the Stratos Division, Fairchild Engine & Airplane Corp., is director of the complete operation of Century Controls. The company, which was incorporated early this year, specializes in design, development and prototype production of accessory control systems and accessories for aircraft.

Members...

A. W. PHELPS, chairman of the board of Oliver Corp., was elected president of the Farm Equipment Institute. He took office at the Institute's annual meeting in Chicago in September. Phelps is sponsor of the 1954 SAE National Production Meeting in Chicago next March.

LEWIS K. SILLCOX, vice-chairman of the board, New York Air Brake Co., has been elected president of the American Society of Mechanical Engineers for 1954. He will take office Dec. 2.

THOMAS P. ALBRECHT, formerly working as an aircraft and engine mechanic at Northwest Airlines, Holman Field, St. Paul, Minn., is now working as an equipment engineer for Northwest, and is involved in retooling for operation of their newly acquired DC-63 aircraft.

RUDOLPH F. GAGG, past-chairman of the Metropolitan Section for 1940–41, has joined the administrative staff of **RAYMOND P. LANSING,** vice-president and group executive of Bendix Aviation Corp. Gagg, who was recently president of Air Associates, Inc., Teterboro, and previously assistant to the general manager of Wright Aeronautical Corp., Wood-Ridge, N. J., will assist Lansing in the administration of seven Bendix divisions.

Gagg

Toth

JOHN A. TOTH has been promoted to assistant general manager at the South Bend plant of The Torrington Co., Torrington, Conn. He was chief engineer at South Bend.

FRANCES L. WEEDEN has been named to the Advisory Committee on Pembroke College by the fellows and trustees of Brown University on nomination of the Brown Alumnae Association. She is a technical editor of SAE Journal.

E. R. HEWITT, grandson of Peter Cooper, unveiled a plaque marking the 100th anniversary of the laying of the cornerstone of the main Cooper Union building, September 17.

CAPT. DANIEL VANCE, JR. is a student officer attending the Ordnance Officers Advanced Course at The Ordnance School, Aberdeen Proving Ground, Md. Previously he was executive officer to the ordnance officer at Atlanta General Depot, Atlanta, Ga.

MAJOR WATSON AMBRUSTER II has been appointed Air Force research and development field representative at the Chemical Corps Proving Ground, Dugway, Utah.

CHARLES B. EISENHAUER has been assigned staff assistant to the vice-president and general manager of Houdaille-Hershey Corp. He was previously manager of manufacturing.

Eisenhauer

Reznek

LOUIS REZNEK, who is with the ICC, Bureau of Motor Carriers, Washington, D. C., has joined the staff of the National Tank-Truck Carriers Conference of the American Trucking Association as safety engineer. Reznek is on the SAE Lighting Committee.

WALTER G. BAIN has been appointed to the newly created position of executive assistant to the president at Republic Aviation Corp., Farmingdale, N. Y. Bain was recently a major general in the U. S. Air Force.

Bain

Henderson

WILLIAM F. B. HENDERSON has been appointed president and general manager of Ryerson & Haynes, Inc., Jackson, Mich. He was previously executive vice-president of E. W. Bliss Co., Detroit.

BEN R. CZYEWSKI, formerly assistant chief draftsman with Breeze Corps., Inc., Newark, N. J., is senior tool designer for the A. O. Smith Corp., Rochester, N. Y.

RICHARD F. BURRIS is now with Bedford Garage Service, San Francisco, as an automotive maintenance engineer. He was previously assistant project engineer at the Southwest Research Institute Automotive Laboratory, San Antonio.

ARTHUR L. BRADLEY has been elected president and general manager of Aero-Detroit, Inc. He was formerly director of engineering and sales for Creative Industries of Detroit.

Bradley

Brams

STANLEY H. BRAMS, formerly Detroit bureau chief of McGraw-Hill Publishing Co., has left that organization and established his own offices at 103 Pallister Ave., Detroit 2.

There he will do a variety of general writing work involving automotive industry activities, and will continue publication of his newsletter on labor-management relations, "Detroit Labor Trends." This publication, which covers labor-management relations in all major industries throughout the country, has had increasingly wide readership since it was established in 1945.

ALBERT S. POLK, JR., formerly senior layout designer, is now senior designer with Glenn L. Martin Co., Baltimore.

WILLIAM F. STEFFEN, formerly a design engineer for Eimco Corp., Salt Lake City, is now design engineer for Bucyrus-Erie Co., South Milwaukee, Wis.

R. G. HOOF has been named hydraulic sales manager, Pacific Division, Bendix Aviation Corp., North Hollywood, Calif. Hoof was previously aircraft sales manager.

HENRY R. GREENLEY has become vice-president and general sales manager of Airway Products, Inc., Pontiac, Mich. He was previously automotive sales engineer for Vickers, Inc., Detroit.

Greenley

Doepel

OTTO J. DOEPEL is now purchasing agent for Metal Products Corp., Miami, Fla. and for Metal Screen Corp., Miami, an affiliate of Metal Products Corp. Doepel was previously chief engineer and purchasing agent for Pro-Tect-U Jalousie Corp., Coral Gables, Fla.

JEROME LEDERER, managing director of the Flight Safety Foundation, Inc., New York, was given the Arthur Williams Award. His citation read in part, "for more than a quarter century of devoted service toward safety in the air."

Lederer who was director of the Safety Bureau of the Civil Aeronautics Board in 1940, is now a director of the Cornell Guggenheim Aviation Safety Center and chairman of the Safety Division of the ASME, as well as a member of many other organizations interested in the preservation of human life.

JOSEPH GESCHELIN, Detroit editor of Automotive Industries, addressed a meeting of the Hydraulics Institute which was held at the Dearborn Inn, Oct. 21. His subject covered the general topic of the editorial requirements of a technical publication and the relationship of editorial requirements to the public relations policies of manufacturers.

Geschelin was also chairman of the automotive session at the National Conference on Industrial Hydraulics held in Chicago Oct. 8 and 9.

GEORGE E. ROWBOTHAN has resigned as technical assistant on the manufacturing staff of Ford Motor Co., Dearborn, Mich. He is now chief draftsman for Niles-Bement-Pond Co., Chandler Evans Division, West Hartford, Conn.

Price Cited for Service

EDMUND T. PRICE, president and general manager of Solar Aircraft Co., San Diego, was cited recently at a gathering of 3000 Solar employees for his quarter-century of service. Price, who joined the company twenty-five years ago as a machinist, was given gold cuff links bearing the Solar service symbol.

NIELS C. BECK has joined the staff of the Armour Research Foundation of the Illinois Institute of Technology as program development engineer. Previously Mr. Beck was Dean of Engineering, Parks College of Aeronautical Technology, St. Louis University. He has been active in the SAE St. Louis Section of which he was Chairman in 1952-1953.

Beck

Cheney

SEYMOUR J. CHENEY is now project engineer on hydraulic and automatic drives for the Hyster Co., Portland, Oregon. Cheney was previously resident engineer in Detroit, Warner Gear Division, Borg-Warner Corp., Muncie, Ind. He has served on various committees in the Detroit Section.

ROBERT E. KRAEMER is a senior project engineer in the engineering laboratory of Ford Motor Co., Dearborn, Mich. He was previously a chassis project engineer for Willys Overland Motors, Toledo.

HAROLD A MENGERT is now employed by the newly formed Stroukoff Aircraft Corp., West Trenton, N. J., as a project design engineer. He was previously with Chase Aircraft Co., Inc. in West Trenton.

JAMES G. PAULY, previously a project engineer for the Fram Corp., Dexter, Mich., is now with the Southwest Research Institute, San Antonio, Texas, as a project engineer.

HAROLD DREW, chief engineer of Vauxhall Motors Ltd., Luton, Bedfordshire, England, has been appointed assistant chief engineer of General Motors Overseas Operations, with headquarters in Detroit. **MAURICE PLATT**, formerly executive engineer for Vauxhall, succeeds Drew as chief engineer.

W. C. LEINGANG, former Chicago plant manager of The Electric Storage Battery Co., has been named assistant general manager of the firm's newly formed automotive products division.

J. C. WRIGHT has transferred his activities from The White Motor Co. in New York City to the White Truck & Bus Co., Paterson, N. J.

JOHN J. DAVIES is now works manager for the Bristol Aviation Services Pty., Ltd., Bankstown, New South Wales, Australia. His previous position was chief maintenance engineer for Trans-Australia Airlines, Melbourne.

JEAN SCHNEEBERGER is now project engineer in the Diesel Division of Packard Motor Car Co., Detroit. He was previously design engineer for Schweitzer & Hussmann, State College, Pa.

EDWARD D. DALL, previously with the A. S. Campbell Co., Detroit, has resigned to organize his own business as a manufacturer's agent.

Students Enter Industry . . .

JAMES F. FENSKE (Massachusetts Institute of Technology '53) is an engineer in the Process Development Section, GMC, Detroit.

WALTER EDWIN HANE (Purdue University '53) has joined the Ford Motor Co., Dearborn, Mich., as a test engineer in the vehicles testing department.

MYRON GOLDBERG (New York University '53) is with the Republic Aviation Corp., New York, as an engineering draftsman.

DAVID L. KLUMB (Syracuse University '53) has joined the Union Electric Co. of Missouri.

ROBERT B. DILLAWAY (University of Illinois '53) is a senior research engineer in the Aerophysics Laboratory, North American Aviation Co., Downey, Calif.

WILLIAM T. WINTUCKY (Fenn College '53) is now with the NACA, Lewis Flight Propulsion Laboratory, Cleveland, as an aeronautical research scientist.

WILLIAM GODFREY STELTZ (Syracuse University '53) has joined the Westinghouse Electric Corp., Lester, Pa., as a mechanical engineer.

ROBERT N. LEVINN (New York University '53) has joined the American General Thermostat Co., New York, as an application engineer.

CLIFFORD DALY (College of the City of New York '53) is a test engineer in the Wright Aeronautical Division of Curtiss-Wright Corp., Wood-Ridge, N. J.

MORTON SCHLER (University of Miami '53) is now with the NACA, Langley Field, Va., as a mechanical engineer.

PAUL R. RHINEHART (Stevens Institute of Technology '53) has joined the Curtiss Propeller Division of the Curtiss-Wright Corp., Caldwell, N. J., as a junior engineer.

DARYL D. NELSON (Cal-Aero Technical Institute '53) is a member of the helicopter design department of McDonnell Aircraft Co., St. Louis, Mo.

ROBERT DAGNA (College of the City of New York '53) has joined the Eclipse-Pioneer Division of Bendix Aviation Corp., Teterboro, N. J., as a junior project engineer.

JACK P. BAGBY (University of Cincinnati '53) is with the Shell Oil Co., Norco, La., as a junior engineer.

HAROLD L. SCHUBERT (Northwestern University '53) is now a junior engineer with Fairbanks Morse & Co., Beloit, Wis.

ANTHONY JOHN KASAK, JR. (Purdue University '53) is a junior engineer with the Bendix Products Division, Bendix Aviation Corp., South Bend, Indiana.

FOREST MERLE WILHITE (Northrop Aeronautical Institute '53) has joined the Douglas Aircraft Co., Santa Monica, Calif., as an engineering draftsman.

LEWIS NETTLETON HILL (Lafayette College '53) is now a student trainee with Combustion Engineering, Inc., New York.

WILLIAM A. SWOPE (Northrop Aeronautical Institute '52) is with Northrop Aircraft, Inc., Hawthorne, Calif. He is a junior engineer.

LOUIS S. HARTMAN (Fenn College '53) is an estimator in the fabrication department of The Paterson Leitch Co., Cleveland, Ohio.

KENNETH L. WHITEHEAD (Carnegie Institute of Technology '53) is with the Curtiss-Wright Aeronautical Division, Wood-Ridge, N. J., as a junior test engineer.

JACK A. PERKINS (Case Institute of Technology '53) is an officer candidate at the U. S. Coast Guard Academy.

WARREN M. BEEVERS (Kansas State College '53) is a second lieutenant in the infantry stationed at Fort Benning, Ga.

WILLIAM N. SCHJERVEN, JR. (Illinois Institute of Technology '53) is a mechanical engineer. He is with Danly Machine Specialties Co. in Cicero, Ill.

ROY A. OJA (Michigan College of Mining and Technology '53) has become a product test engineer for Ford Motor Co., Dearborn, Mich.

JAMES W. BOHLANDER (Purdue University '51) is a lieutenant, junior grade, at the U. S. Naval Academy, Annapolis, Md., teaching thermodynamics and fluid mechanics.

HARRY R. LEE, (University of New Hampshire '53) is in the U. S. Air Force.

Continued on Page 103

Obituaries

WILLIAM FAIRHURST

William Fairhurst, 61, vice-president and sales manager of Dana Corp., died suddenly October 2 in Wernersville, Pa. He had been on a business trip to the Parish Pressed Steel Co., a subsidiary of the Dana firm, in Reading, Pa.

Fairhurst became sales manager of Spicer Mfg. Co. in Plainfield, N. J. The firm's offices were moved to Toledo in 1928, and Fairhurst was elected vice-president in '35.

Previously he had served an engineering apprenticeship at Packard Motor Car Co., Detroit, and had served in World War I. A captain, he commanded Company B, Twelfth Machine Gun Batallion, Fourth Infantry Division. He saw action in France and Germany.

After the war, Fairhurst was an engineer for Denby Motor Truck Co. and then became district sales manager in Detroit for Taft-Pierce Mfg. Co.

He was born in Plainfield, N. J., and was educated in public schools there. He attended Peddie Prep School, Heightstown, N. J., and received his B.A. in mechanical engineering from the Sheffield School of Science, Yale University.

For many years he served in the vestry of St. Mark's Episcopal Church, Toledo, where he was also senior warden. Besides holding membership in SAE, he was a member of the Zenobia Temple, Shrine, and was a 32nd degree Mason.

BAYARD D. KUNKLE

Bayard D. Kunkle, a member of the board of directors of General Motors Corp. and a retired vice-president of General Motors, died September 14. He would have been 71 in October.

Kunkle began work for GMC as supervisor of production in the Klaxon horn department of the Remy Electric Co., Anderson, Indiana in 1925. Later he joined Frigidaire Corp., Dayton, and in 1929 was appointed manager of production engineering for Frigidaire.

After a year he was president and general manager of Delco Products Corp., Dayton, and after four years was assistant to Charles E. Wilson, then GMC's vice-president.

Later as a vice-president of General Motors, Kunkle was in charge of personnel, manufacturing and process development. He retired from all duties, except that of board member, four years ago.

Born in Steelton, Pa., Kunkle took a college preparatory course at Harrisburg Academy. He received his B.S. in electrical engineering from the Pennsylvania State College from which he also received the E.E. degree a year later, 1908. Then he entered industry as assistant chief electrician with the United Electric & Valley Traction Co.

Kunkle joined Westinghouse Electric and Mfg. Co. later and remained there until 1916 doing various work on the electrical systems of automobiles.

Then he went with Caskey-DuPree Mfg. Co., Marietta, Ohio, as chief engineer and superintendent of production for two years, but rejoined Westinghouse in 1922 as an assistant superintendent at the East Springfield Works, Springfield, Mass.

He is survived by his wife, Mrs. Ethel Miller Kunkle and a daughter, Mrs. Donald Sunderlin.

JOSEPH H. BURROUGHS, JR.

Joseph H. Burroughs, Jr., secretary and assistant treasurer of the Kittaning Coal Co., Philadelphia, died August 11. He was 71.

Designer of the elevator safeties used in the Woolworth Building, Burroughs was once in charge of design, manufacture and installation of safety devices for the Otis Elevator Co., New York.

Prior to that he was assistant to the president of the Chambersburg Engineering Co., Chambersburg, Pa., and was responsible for the designing of all types of machinery. His position at Chambersburg Engineering Co. was his first upon graduation from the University of Pennsylvania.

A native of Philadelphia, Burroughs attended Central Manual Training School there and received his B.S. in mechanical engineering from the University of Pennsylvania.

Later he did designing for the Cambria Steel Co., Johnstown, Pa., and the Baldwin Locomotive Works, Philadelphia.

In 1917 he entered the U.S. Army and was a captain of coast artillery. After his Army service, he rejoined Otis Elevator Co. Later, at the Kelsey Motor Co., Belleville, N. J., he worked on the design of the 1923 and '24 models of the Kelsey automobile.

A member of SAE for almost 30 years, Burroughs was also a member of the American Society of Mechanical Engineers.

PETER LAMBERTUS

Peter Lambertus, president and general manager of the American Bearing Corp., Indianapolis, died August 6. He was 66.

Lambertus was previously vice-president and general manager of the American Broadway Corp., Indianapolis, Ind., from 1922 to 1941. He was in charge of engineering and development there.

Born in Hungary, he became a citizen of the United States.

ERICH H. LICHTENBERG

Erich H. Lichtenberg, patent research engineer for Koehring Co., Milwaukee, died in St. Mary's Hospital, Milwaukee, after a long illness, Aug. 28. He was 68.

With Koehring for 42 years, Lichtenberg was named patent research engineer in 1940. Before that he had been chief engineer.

Described as "a pioneer in the development of modern concrete mixing and paving equipment and methods," he held many patents on construction machinery. He developed equipment now used throughout the United States on road and dam work. At one time he was chairman of the standards committee of the Power Crane and Shovel Association and the Mixer Manufacturers' Bureau to standardize certain construction equipment.

Lichtenberg was a member of the Army Reserve for many years, and did research on tank construction before the first World War. In 1939 he was made a lieutenant colonel.

He studied engineering from International Correspondence School lessons, and previously had attended high school at Fond du Lac, Wis., and grammar school in Princeton, Wis.

He held membership in the Koehring Quarter Century Club, the American Society of Mechanical Engineers, the Milwaukee Association of Commerce and the Bethesda Lutheran church, as well as SAE.

LT. DONALD G. BRIGHAM

Lt. Donald G. Brigham, 23, was killed in service May 29.

Lt. Brigham attended the University of Wisconsin where he received his Bachelor of Science degree earlier this year before entering the U. S. Air Force.

He joined SAE in 1951 and was an active member. He was also a student officer at the University.

YOU'LL . . .

. . . be interested to know that . . .

POSTAL PEREGRINATIONS: Back in 1943 SAE mailed a membership certificate to E. F. DeTIERE, JR., in Montclair, N. J., after his being elected to junior membership by Council. Last month, the Post Office returned the 10-year old certificate to SAE headquarters marked "not deliverable." Incidentally, since that time DeTiere has been transferred to full membership and has received his full member certificate.

★ ★ ★

B. E. RICKS, of Thompson Products, Inc., has been appointed by SAE Vice-President NEIL PETERSEN to serve as a member of the Production Activity Committee for the remainder of 1953.

★ ★ ★

RECOGNITION CERTIFICATES — Starting in October the Society will proudly present recognition certificates to 65 members who will have completed their 35th year of dues paying membership, and to 163 who will have rounded out 25 years of active membership. Sections and Groups, who last year cooperated so well in successfully initiating the recognition program, again will be asked to make the presentations to members residing in their territories. This year the total number of certificates to be presented is 228 . . . last year 1260 certificates were bestowed when all members in the two groups received recognition.

★ ★ ★

SAE MEMBERSHIP hit an all-time high with a total of 18,242 paid members at the end of the fiscal year, Sept. 30, 1953, reports J. H. BOOTH, chairman of the SAE Membership Committee. He also advises that the more than 2600 applications received this past year set a new high.

★ ★ ★

THE Society is co-sponsoring a luncheon honoring engineers' contributions to powered flight on December 1 at the Hotel Statler in New York.

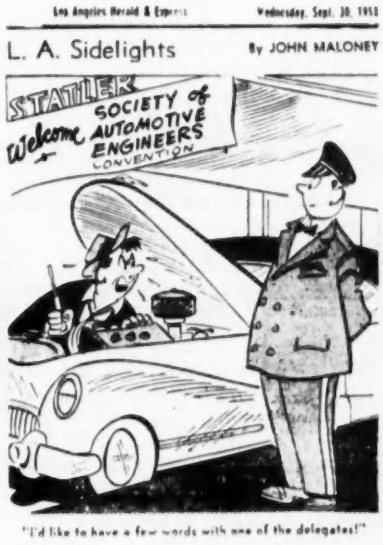
Igor I. Sikorsky, aviation pioneer, will give the principal address. Roy T. Hurley will preside.

Other sponsors of the luncheon are the American Society of Mechanical Engineers and the Institute of the Aeronautical Sciences.

NEWS OF SAE

FLASHBACK . . .

. . . from '53 National Aeronautic Meeting in Los Angeles.


Los Angeles Herald & Express — Wednesday, Sept. 30, 1953

L. A. Sidelights — By JOHN MALONEY

"I'd like to have a few words with one of the delegates!"

National Meetings . . .

Meeting	Date	Hotel
	1954	
Annual Meeting and Engineering Display	Jan. 11-15	The Sheraton-Cadillac Hotel and Hotel Statler, Detroit
Passenger Car, Body, and Materials	March 2-4	Hotel Statler, Detroit
Production Meeting and Forum	March 29-31	The Drake, Chicago
Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display	April 12-15	Hotel Statler, New York City
Summer	June 6-11	The Ambassador, Atlantic City, N. J.
West Coast	Aug. 16-18	Hotel Statler, Los Angeles
Tractor and Production Forum	Sept. 13-16	Hotel Schroeder, Milwaukee

SAE Section Meetings

Atlanta—Dec. 11

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Baltimore—Dec. 8

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Buffalo—Nov. 12 and Nov. 18

Nov. 12—Hotel Sheraton. Dinner 6:30 p.m., meeting 8:00 p.m. Nuclear Power and Industry—Walter E. Donaldson, production development engineer, Dow Chemical Co.

Nov. 18—Rochester Branch Meeting. Future Trends in Engine Progress—D. F. Caris, engine development, Research Laboratories Division, GMC.

Central Illinois—Nov. 12

Jefferson Hotel, Peoria. Dinner 6:30 p.m., meeting 7:45 p.m. Gear Design—Prof. Earl Buckingham, M.I.T. Joint Meeting with ASME.

Chicago—Nov. 16 and Dec. 8

Nov. 16—South Bend Division, Hotel LaSalle, South Bend, Bronzewood Room. Dinner 6:45 p.m., meeting 8:00 p.m. A New Technique for Investigating Jet Engine Compressor Stall and Other Transient Characteristics—W. J. Kunz Jr., chief engineer of electronics, Bendix Products Division, Bendix Aviation Corp.

Dec. 8—Hotel Knickerbocker, Chicago. Grand Ballroom. Dinner 6:45 p.m., meeting 8:00 p.m. Small Gasoline Engines—2-cycle versus 4-cycle—F. Burrows Esty, assistant chief engineer, Wisconsin Motor Corp.; S. D. Pollow, chief engineer, Power Products Corp. Social half-hour sponsored by Wisconsin Motor Corp., Power Products Corp., and Borg & Beck Division, Borg-Warner Corp.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

Cincinnati—Nov. 16

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Cleveland—Nov. 9

NACA Lewis Flight Propulsion Laboratory. Dinner 6:30 p.m., meeting 7:30 p.m. Full-Scale Aircraft Crash Fire Research—I. Irving Pinkel, associate chief, Physics Division, NACA, Cleveland Hopkins Airport.

Colorado—Nov. 9

Coleman Motors Plant. Meeting 8:00 p.m. 4-Wheel Drive and Special Units—Mr. Anderson, sales department, Coleman Motors, Inc. This will feature a plant tour.

Dayton—Nov. 17

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Detroit—Nov. 16, Dec. 1 and 7

Nov. 16—Rackham Educational Memorial Building. Dinner 6:30 p.m., meeting 8:00 p.m. Helicopters of Today and Tomorrow—I. I. Sikorsky, engineering manager, Sikorsky Aircraft Division, United Aircraft Corp. Dinner speaker—Walter Albert, Naval Airstation, Grosse Ile, Mich.

Dec. 1—General Motors Truck & Coach Plant, Pontiac, Michigan. 1:30 p.m. Junior Group Field Trip. Coach operation. Limited to SAE Junior Members only.

Dec. 7—Rackham Educational Memorial Building. Dinner 6:30 p.m., meeting 8:00 p.m. Styling, American and European—George Romney, executive vice-president, Nash-Kelvinator Corp.

Indiana—Nov. 19

Marott Hotel, Indianapolis. Dinner 7:00 p.m., meeting 8:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass. Social Half-Hour 6:30 to 7:00 p.m. Sponsored by Schwitzer-Cummins Co.

Kansas City—Nov. 17

American Legion Hall, Linwood & Pasco. Dinner 7:00 p.m., meeting 8:00 p.m. Electrical Trouble Shooting—H. T. Dubendorff, field service engineer, Echlin Mfg. Co.

Metropolitan—Nov. 12 and 18

Nov. 12—Brass Rail Restaurant, Fifth Ave. & 43rd Street. Dinner 6:30 p.m., meeting 7:45 p.m. Progress in the Development and Application of Combustion Gas Turbines—B. G. Hatch, General Electric Co.

The Application of Gas Turbines in the Aircraft Industries—J. M. Pederson, Aircraft Gas Turbine Divisions, General Electric Co.

Nov. 18—Essex House, Newark, N. J. Meeting 7:45 p.m. How Mack Thermodyne Diesels Better Sustained Economy—W. J. Pelizzoni, Mack Mfg. Corp.

Mid-Michigan—Nov. 16

Owosso City Club, Owosso, Mich. Dinner 7:00 p.m., meeting 8:30 p.m. Truck Fleet Operation—Richard L. Hargrove, vice-president, Liberty Highway Co.

Milwaukee—Nov. 16

Milwaukee Athletic Club. Dinner 6:30 p.m., meeting 8:00 p.m. How the Metallurgist Can Help the Designer—A. S. Jameson, supervisor, Metallurgical Research Laboratory, International Harvester Co.

Mohawk-Hudson—Nov. 10 and Dec. 8

Nov. 10—Dinner 6:45 p.m., meeting 8:00 p.m. Modern Lubricating Oils for Modern Internal Combustion Engines Cars, Trucks and Buses—Roland W. Flynn, senior staff engineer, Gulf Oil Corp.

Dec. 8—Circle Inn, Latham, N. Y. New Air Applications of Brakes and Other Automotive Devices—J. V. Ralston, manager, sales engineer, Bendix-Westinghouse Co.

Northern Calif.—Nov. 18

Dinner 7:00 p.m., meeting 8:00 p.m. Free Piston and Turbine Compounded Engine—Status and Development—A. L. London, professor of mechanical engineering, Stanford University.

Northwest—Nov. 6

Stewart Hotel. Dinner 6:30 p.m., meeting 7:30 p.m. Washington Highways and Their Future—W. A. Bugge, director, State Department of Highways, Olympia, Wash.

Oregon—Nov. 19

Congress Hotel. Dinner 7:00 p.m., meeting will be technical. Diesel Engine Service—Paul Dougherty, Cummins Diesel Co.

Philadelphia—Nov. 11

Engineers' Club, Philadelphia. Dinner 6:30 p.m., meeting 7:45 p.m. Indianapolis Racing Car Design—Robert T. Jackson, sales engineer, Perfect Circle Corp. Mobilgas Economy Run

—H. S. Kelly, staff engineer, Socony-Vacuum Oil Co., Inc.

Pittsburgh—Nov. 24

Mellon Institute. Dinner 6:30 p.m., meeting 8:00 p.m. Analysis of Bearing Failures—H. W. Luetkemeyer, Cleveland Graphite Bronze Co.

St. Louis—Nov. 18

Dinner Meeting. Gatesworth Hotel. Engineering Frontiers—1953 SAE President Robert Cass.

Southern Calif.—Nov. 12 and Dec. 17

Rodger Young Auditorium, Los Angeles. Dinner 6:30 p.m., meeting 8:00 p.m. The Future Turbine Type Commercial Transport—H. E. Hoben, American Airlines, Inc.; W. C. Lawrence, American Airlines, Inc.

Dec. 17—Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. The Preignition Problem—W. E. Morris Petroleum Laboratory, E. I. duPont de Nemours and Co., Inc.

Southern New England—Dec. 3

Springfield, Mass. Dinner 6:30 p.m., meeting 8:00 p.m. Development of an Improved Automotive Diesel Combustion System—Bruno Loeffler, executive engineer, Mack Manufacturing Co. Presentation of 25- and 35-year certificates.

Spokane-Intermountain—Nov. 17

Caravan Inn. Dinner 6:30 p.m., meeting 7:30 p.m. Fairchild Air Force Base, U. S. Air Force Personnel.

Syracuse—Nov. 23

Museum of Fine Arts. Dinner 6:30 p.m., meeting 7:30 p.m. Automotive Styling—Stanford Landell, sales manager, Brown-Lipe Chapin. Tour through new General Motors plant, courtesy of general manager, Norman Ross.

Texas Gulf Coast—Nov. 13

Ye Old College Inn, Houston, Texas. Dinner 6:00 p.m., meeting 7:30 p.m. Latest Developments on Tires, Rims, and Their Maintenance—T. A. Robertson, development department, Firestone Tire & Rubber Co.

Virginia—Dec. 9

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Washington—Dec. 7

Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Western Michigan—Nov. 17

Bill Sterns Steak House, Muskegon. Dinner 6:30 p.m., meeting 8:00 p.m. Military Ground Vehicles—A. B. Willi, Military Division, Continental Motors Corp.

Control for Hypothetical Ramjet Must Manage 300,000 Hp, Fit in 4 Cu Ft

J. C. Wise, Marquardt Aircraft Co.

Based on paper "Holding the Reins on 300,000 Horsepower" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 2, 1953.

SINCE most ramjet powered vehicles are pilotless, the control system is complicated by having to take over the pilot's duties. In addition, the ramjet is the epitomy of compactness, yet is capable of producing over 300,000 hp. Accordingly, the control system requirements are numerous and present a challenge to the control engineer.

To illustrate the extremes to be expected in the control art, let us assume a ground launched interceptor type vehicle, powered by a single ramjet engine. This hypothetical missile and fictitious engine represents a possible and even desirable combination, but is nonexistent and, to our knowledge, not contemplated. Existing ramjets employ fixed geometry engines. Here, we assume some advance over the present state of ramjet development and control system requirements.

This hypothetical missile will follow the flight path shown in Fig. 1. A booster rocket aids the available ramjet thrust to accelerate the missile to a flight Mach number of 3, which is reached after about 6 sec boost and at an altitude of 10,000 ft. The vehicle then climbs on ramjet power alone to 80,000 ft where it levels off and cruises at Mach 3 under the influence of the guidance system until the target is sighted. At this point, it may be assumed that the target begins evasive maneuvers and the missile takes the necessary action to seek and destroy it.

To have sufficient thrust for recovery from these violent maneuvers and to assist the boost phase, by keeping the rocket fuel required for boost at a minimum, a completely variable geometry engine is assumed to power the missile. This engine is 30 in. in diameter and both inlet and exhaust nozzle are capable of continuous variation between minimum and maximum stops.

The engine weighs about 1260 lb. This is derived from a specific weight figure of 50 lb of thrust per engine pound and is an average of several published values. Weight is of little significance to the control engineer, but it does indicate the vibrational

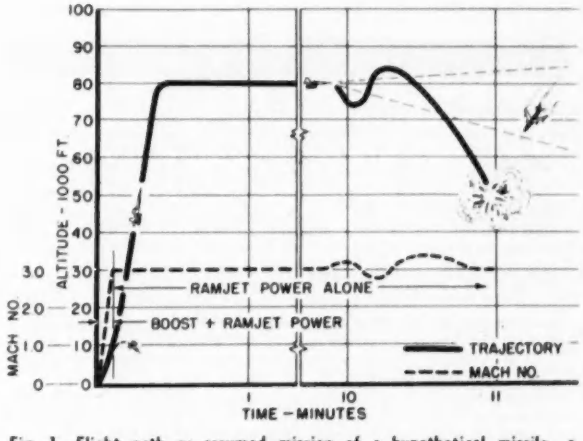


Fig. 1—Flight path or assumed mission of a hypothetical missile—a ground launched interceptor type vehicle, powered by a single completely variable geometry ramjet engine

Interest Runs High In 1953 Beecroft Lecture

THIS year's Beecroft Memorial Lecture was received with unusual enthusiasm at its presentation October 19 before 200 participants in the National Safety Congress in Chicago.

This seventh Beecroft Lecture was presented by W. Earl Hall, editor of the Mason City Globe-Gazette and a veteran of thirty years' service in the safety field. The complete text of the Lecture begins on page 51 of this issue.

problem encountered when considered in relation to the tremendous horsepower output.

From the foregoing and published values of specific fuel consumption and thrust coefficients it can be determined that the total space available in the inner body for metering equipment is approximately 4.4 cu in., which actually provides less than half that space for use in most applications. Therefore, the fuel pumping system, fuel metering system, fuel distribution system, necessary valving, and instrumentation for metering vast quantities of fuel required, must be crowded into a space occupying less than 2 cu ft.

The complexity of the control problem is indicated by Fig. 2 which establishes the range of physical conditions which the assumed engine control system may encounter. Obviously, the environment in which a ramjet fuel system must function is considerably more severe than generally encountered in present-day turbojet installations.

Due to the absence of a pilot, the engine control system must also provide an overspeed limiting function for the vehicle. In the variable geometry case the method of thrust modulation used would be connected to a flight speed sensing device to provide a control loop capable of varying thrust as a function of flight Mach number.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

	10,000 FT MACH 3	80,000 FT MACH 3
HORSEPOWER	370,000 (180 DIESEL LOCOMOTIVES)	2000 (15% MAXIMUM AVAILABLE FOR CRUISE)
FUEL FLOW	45 LBS/SEC MAX THRUST (2 PAILS)	0.27 LBS/SEC (15% MAXIMUM THRUST)
STAGNATION AIR TEMPERATURE	1100°F	780°F
STAGNATION AIR PRESSURE	260 PSIA	10.5 PSIA
MAX VIBRATION EXPECTED	UP TO 50 Gs @ 1000 CPS VIBRATION RANGE 0-1500 CPS	UP TO 2 Gs @ 1000 CPS VIBRATION RANGE 0-1500 CPS
MAX CONTINUOUS ACCELERATION	25 G's	7 G's

Fig. 2—Illustrating the range of physical conditions which may be encountered by the assumed ramjet engine control system. The two points chosen are the 10,000 ft Mach 3 point at maximum thrust, and the 80,000 ft Mach 3 point with thrust reduced to requirement for level flight cruise

Small Diesels Winning Favor Abroad

Based on paper by

A. W. GOSLING

F. Perkins, Ltd.

AN increasing proportion of British vehicles between 5600 and 6700 lb unladen weight are being fitted with diesels while a large number of existing gasoline engine powered vehicles are being changed over to diesels. There is also a growing demand for diesels for vehicles weighing under 5600 lb.

Four-cylinder diesels, popular for light vehicles and trucks up to 12,000 lb gross weight, are even being installed in the London taxis where they give a consistent 33 to 36 mpg. Although a little noisier, passenger and driver comfort is satisfactory.

The fact that widely differing combustion systems are in use is an indication that the perfect combustion chamber for all purposes does not exist. The open chamber has the highest thermal efficiency because of low heat and pumping losses, gives good cold starting, but relies heavily on maintenance of a high degree of fuel atomization and is somewhat difficult to make in small sizes. Its effectiveness to operate over a wide speed range is reduced by the need for some form of restriction in air intake to produce air swirl. The precombustion design gives good combustion without as great a reliance on the condition of the atomizers which can be extremely simple. It is capable of digesting fuels of widely different quality, but due to heat and pumping losses it gives a relatively high fuel consumption and poor cold starting characteristics. It can operate over a wide speed range due to the absence of air intake restrictions. The swirl type has characteristics lying between the two extremes.

In Britain, where fuel quality is high, the desire for utmost economy, together with speed restrictions, have combined to favor the open chamber type. On the Continent, and in Germany in particular where pre-war fuels were of poor quality, manufacturers have favored the pre-combustion or swirl chamber design, even for larger sizes, and with the present trend toward higher speeds and smaller cylinder sizes, separate chamber designs are still preferred.

Our important problem is to reduce first cost of the engine and we are well aware of the need for development, particularly on fuel injection equipment, to cut costs. The diesel must be capable of being a gasoline engine replacement and, as far as possible, give equivalent performance over a

Continued on Page 108

from the... Sections

Technical sessions, dinner meetings, films and coffee hours marked the beginning of another year of Section meetings. So far this fall, the automobile of tomorrow has proved a popular topic at the Texas, Twin City, and Texas Gulf Coast Sections, as well as at the South Bend Division of the Chicago Section.

South Bend Division of Chicago

Field Editor
Dorr W. Miller

Sept. 22—The Aluminum Co. of America's J. H. Dunn used a novel form of presenting his paper, "Light Metals in the Car of the Future." Dunn built on stage the skeleton of tomorrow's auto with aluminum and magnesium components.

There is a significant trend toward light metals, he said. In 1938 the proposed General Motors' car of the future was all steel with practically no light metals. The 1948-49 version was mostly aluminum and magnesium. During the next 20 years, (as light metals prove to do the job better or cheaper) it is predicted instead of the present 15 to 20 pounds of light metal, nearly 200 pounds will used.

Mid-Michigan

Field Editor
C. A. McKinney

Sept. 28—The modern sports car will strive for greater comfort, better visibility, and pleasanter driving characteristics than ever found in this type of car, according to Mauri Rose and Z. Arkus-Duntov. Rose and Duntov, both experienced race-car drivers, who have been working on the design and development of Chevrolet's Corvette, were speakers at the Section's first meeting, a foreign and domestic sports car exhibit at Lansing, Mich. The Corvette, M-G, Jaguar, Nash-Healy, and Mercedes X-300 were among the cars shown in the auditorium of the Oldsmobile Engineering Building.

Hawaii

Field Editor
R. G. Deemer

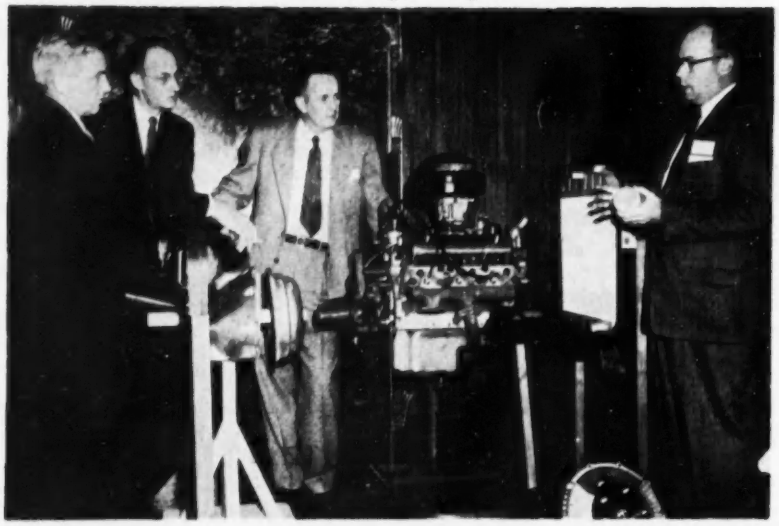
Aug. 18—Across the Pacific, Hawaii members attended a comprehensive program on air brakes, presented by Automotive Service Co.'s Gene Fitch. Fitch revealed that, in his experience, compressor life in Hawaii between overhauls was frequently in the 20,000 to 30,000-mile bracket as opposed to the West Coast figures of 90,000 to 125,000-miles.

"Teamwork in Transit," a film depicting trucks as the core of the American economy, was focused on precision machines and processes used in the manufacture of air brake parts. The latter part of the picture was a resume of the development of air brakes. The film covered their introduction in the early 1920's through the 1930's, when air brakes became standard on nearly all public transportation, to the present day.

Another movie "Air Brake Operation and Maintenance," demonstrated operation and maintenance principles by use of a mock-up. It also set the stage for Fitch's presentation on the location of troubles

South Bend Division of Chicago (Sept. 22)

From Section Cameras



BUILDING TOMORROW'S AUTO, J. H. Dunn (extreme right) uses aluminum and magnesium components. Watching the demonstration are: (l to r) H. E. Churchill; W. A. Gebhardt; T. H. Thomas.

M. R. BENNETT (third from right) Chicago Section Chairman, sits in at the South Bend meeting. To his right are M. P. De Blumenthal, Chicago Section Secretary, and W. A. Gebhardt, Vice-Chairman of Aircraft in the Section. At the other side of Bennett are: (l to r) K. H. Barnes, American Wheelabrator; H. E. Churchill, Studebaker; D. Avery, Alcoa; speaker Dunn, Alcoa; and T. H. Thomas, Bendix.

Twin City (Sept. 18)

PRESIDENT CASS POINTS out a need for smaller, cheaper cars. Listening are: (l to r) Vice-Chairman D. J. Briening, D. W. Onan & Sons; Chairman N. A. Hall, University of Minnesota; Secretary L. W. Foster, Scott-Atwater; Past-Chairman B. J. Robertson, Minneapolis-Honeywell.

in a typical air brake installation.

The evening's coffee speaker, George Turner of American-Hawaiian Motors, gave general information to the group about the new shell-molding process. Molds were then shown to the men.

Sept. 21—Friends and members visited Barber's Point Naval Air Station to witness a ground-controlled approach. To enable the group to see the demonstration plane at a distance of 6½ miles, a blackboard illustrated the flight pattern and commentary was heard via a public address system. Members followed the plane to a perfect landing directly in front of them.

They were then taken through the plane storage area where planes were identified and their purposes explained by Operations Officer Lieutenant Leonard, and Base Public Information Officer, W. O. Carr.

An F8F jet photographic plane was disassembled to permit overhaul of the Pratt & Whitney J42 P-8 engine. Commander Hathaway and Chief Robertson gave a brief description of the engine's operation. Questions, generated by the powerplant, centered around jet engine life.

The group learned that periods between overhauls commonly range between 250 and 450-hr. The hours may, in some cases, be as low as 100. At the other extreme is the 1000-hr. figure which is being approached by planes on the Island.

After a charcoal-broiled steak dinner, Chairman George Wheelright introduced Lt. Leonard, representing Capt. Leslie. Leonard officially welcomed the party to the station.

"Diesel Race Car," a film about the development of the Cummin's Special (No. 28) from the dream stage, to the 500 mile Indianapolis classic was shown by the courtesy of Harrie Moxie of Von Hamm Young Co., Ltd.

Texas Gulf Coast

Field Editor
W. B. Tilden

Sept. 12—Future motorists will get more fun out of driving according to Paul H. Richard, an E. I. du Pont automotive technologist.

Automatic transmissions will grow in popularity and will give improved performance while lowering the car's octane requirement, and preignition will gradually displace knock as the limitation on allowable compression ratio.

Richard said the trend is toward higher octane fuels with probable greater use of tetraethyl lead. Ninety-six-octane-number fuel may be available nationally in 1956.

Other trends indicate compression ratios will continue to increase with a probable maximum of about 9/1 or 9.5/1 for the next few years. The most popular engine design will be the 90-deg. V-8 with overhead valves.

Texas

Field Editor
H.C.Anderson

Sept. 18—Today's car is made solely to enhance convenience rather than durability, Lou Mecklenburg told Texas Section members. The car of the future, he said, will continue this trend to an even greater degree. Mecklenburg is immediate past-chairman of the Kansas City Section and is Ford Motor Co.'s Southwestern regional sales manager.

The Texans watched "Tomorrow Meets Today," a film showing the designing, testing and evaluating engineered into a new model years ahead of production planning.

Buffalo

Field Editor
E. W. Chapman

Sept. 17—Two-hundred members and guests of Buffalo Section saw a movie about the latest auto-crash fatalities. The research for the film was conducted by Edward R. Dye, head of the Industrial Research Division, Cornell Aeronautical Laboratory.

They learned that safety belts attached to the car-frame and crash pads on the steering wheel and dash-board give a much greater chance of survival in high speed auto crashes than could ever be achieved by other means.

A tour through the Cornell Aeronautical Lab was also on the program. Highlights included inspection of the 12-ft. wind tunnel, the power area and its control room, and the hypersonic wind tunnel—the next step above supersonic airspeeds in the 10,000 mph class.

Northern California

Field Editor
R. Gray

Sept. 23—The Northern-California members enjoyed listening to Ralph De Palma, famed race driver, and his "panel" discuss racing problems in the old days and today, both from the driving and engineering standpoint. The panel included Frank Elliot, fleet engineer for Ethyl Corp., Los Angeles; Earl Cooper, retired from Union Oil Co.; Bud Wiget, mechanical engineer, Bud Wiget Engineering Co.,

Northern California (Sept. 23)

From Section Cameras

EXAMINING photographs of early race-cars are (l to r) famed race-driver Ralph De Palma and two of his panel members, Frank Elliot, Ethyl Corp., and Earl Cooper, retired from Union Oil Co.

HAVING DINNER before the meeting are: (l to r) Chairman J. A. Edgar, Shell Oil; V. C. Peterson, Section Vice-Chairman of Transportation and Maintenance, Municipal Railway of San Francisco; and De Palma.

Buffalo (Sept. 17)

BUFFALO MEMBERS have their picture taken before seeing a film in the Cornell Aeronautical Laboratory.

Northwest (Sept. 18)

AT THE DINNER TABLE are: J. Palsulich, Cleveland Graphite Bronze; speaker Leo Schamadan, Cleveland Graphite Bronze; Chairman R. C. Norrie, Kenworth; R. E. Fleischer, Colyear Motor Sales; and D. H. Mikkelson, L. A.-Seattle Motor Express.

Concord, Calif.; and Thomas Frane-Thompson, associated with Shell Oil Co.

"The Fabulous 500," a color film shown by the courtesy of General Petroleum Corp., with whom De Palma is now associated, gave an excellent presentation of the highlights of the 1953 Indianapolis 500-mile race.

Twin City

Field Editor
S. H. Knight

Sept. 18—SAE President Robert Cass, too, touched upon the subject of future automobiles. Public transportation in the face of rising costs, he said, cannot cope with suburban development projects and carry out the work of transporting people to and from their homes. Private cars must assume the burden.

Those people in the income group that cannot pay half their year's income for a low-priced car, which sells for about $2200 today, will need cheaper models. The current "low-priced" car has ceased to be the Model-T version, and has become a highly developed luxury vehicle.

Emphasis in the passenger car field should be one toward a lighter, smaller car, Cass said. Somewhere along the line marketing specialists have called upon engineers to produce cars of such power that they tend to be quite unrealistic in city operation.

Cass said that while automatic transmissions are reliable, they cost too much and are complex. They should be along the lines of simplicity and economy in both operation and manufacture.

Northwest

Field Editor
W. M. Brown

Sept. 18—"Adequate bearing maintenance is cheap," Leo Schamadan told Northwest Section members. Schamadan is field engineer for Cleveland Graphite Co.

"It is cheap," he continued, "because it provides more hours of engine operation between major overhaul periods. This is what pays off!" Inadequate maintenance, on the other hand, he said, can mean severe bearing failures and increased operational costs.

"The Cost of Adequate Bearing Maintenance" covered bearing design and materials, lubrication and oils, analysis of failures, maintenance and preventative maintenance.

Canadian

Field Editor
F. G. King

Sept. 30—"Man with a Thousand Hands," a film story about the battle with nature now taking place in British Columbia (the aluminum hydro-electric project) was seen by Canadian Section.

A pump gun was presented as a Section gift to A. W. Denny, immediate past-chairman, by A. A. Scarlett, his successor.

St. Louis

Field Editor
A. W. Zub

Sept. 15—St. Louis Section took a conducted tour through the American Wine Co. They learned how the finest champagne is made, and . . . what to do with it after it is made!

Williamsport

Field Editor
Paul Cervinsky

Oct. 5—Once an experimental toy, the helicopter is now an important life-saving vehicle, Cornell Slivinsky told the Williamsport Group. Slivinsky is staff design engineer in charge of rotor design, Piasecki Helicopter Corp. He said to make helicopter transportation more lucrative for commercial use:

1. the price must be attractive
2. the life of component parts must be extended
3. other and better powerplants with lower noise levels must be achieved, and
4. the metal rotor blade must be developed and perfected.

Only the turbine type is being pursued at Piasecki as the coming powerplant, he said, because of its higher operating speeds and lower noise level.

Sept. 14—A view into the past, instead of the future, was had by members of Williamsport Group. Members saw "Lest We Forget," a film-review of old makes of cars. "Oil Films in Action" and "Styling the Motor Car" were also shown after a dinner at the Antler's Club.

TECHNICAL COMMITTEE *Progress*

More Projects Planned by Aeronautical Drafting Group

OTTO Kirchner, chairman of S-1, the Aeronautical Drafting Manual Committee, disclosed at its last meeting that the newly revised Aeronautical Drafting Manual has received much wider usage in the aviation industry than the earlier versions. Several companies, he pointed out, have indicated their desire to base their company drafting requirements on the Manual.

He also announced that P. G. Belitsos of General Electric has been named as a representative of SAE on the ASA Drawing and Drafting Room Practice Committee (Y-14).

The S-1 Committee has six new projects planned, as follows:

1. Gears. The purpose of this project is to bring the gear data contained in the Manual up to date and in line with the gear dimension information published by the ASA and the American Gear Manufacturers Association. Project sponsor is S. B. Elrod of Purdue University.

2. Alterations and Engineering Changes. Simplified methods of presenting drawing alteration changes, engineering change procedures, and the like, will be developed under this project.

3. Parts Lists. The military services require that detailed parts lists be included on all work drawings. Thus, the idea behind this project, sponsored by Mr. Belitsos, is to develop a satisfactory method of presenting these lists.

4. Hair Springs. The purpose of this project, which is sponsored by L. E. Trefney of Eclipse-Pioneer, is to develop dimensional requirements for hair springs. These would then be added to the Springs Section of the Manual.

5. Jewel Bearings. Mr. Trefney is also sponsoring this project to develop a recommended dimensional system suitable for jewel bearings.

6. Reduction of Cross-Hatching. Prof. Elrod is developing a proposal for ways to reduce the amount of cross-hatching needed on drawings. It is felt that cross-hatching is taking too much of the draftsman's time.

7. Simplified Spring Drawings. J. Stannard of Pratt & Whitney is to determine the possibilities for developing ways of presenting spring drawing information that will take less drafting time.

S-1 Meets Again

At a recent meeting of S-1, members and guests posed for a photograph. They are, starting from left to right rear of table: H. M. Favor, Aeroproducts—Allison Division, GMC; C. J. Faust, Fairchild Engine Division; M. L. Stoner, SAE; Chairman O. E. Kirchner, American Airlines System; L. E. Trefney, Eclipse-Pioneer Division, Bendix Aviation Corp.; A. E. Whitney, Lear, Inc.; C. R. Plum, General Electric Co.; S. B. Elrod, Purdue University; J. G. Perrin, consultant; G. A. Evans, Fairchild Aircraft Division; P. G. Belitsos, General Electric Co.; H. W. Searight, Grumman Aircraft Engineering Corp.; starting from left to right in front of table: J. A. Kabrud, Boeing Airplane Co.; P. V. Richards, Wright Aeronautical Division; W. B. Billingham, Hamilton Standard Division; W. Novak, Grumman Aircraft Engineering Corp.; J. Stannard, Pratt & Whitney Aircraft

Cracking Down on the Variety of Aircraft Electric Motors

THIS SAE technical committee is out to reduce the number of electric motors used in military aircraft—now about 500. The U. S. Navy asked SAE to undertake such a standardization job—and above you can see members of SAE Subcommittee A-2M, Motors, hard at it. Seated around the table in a clockwise direction are: P. W. Franklin, Royal Electric; D. L. Boyd, Air-Way Electric; H. L. Hayden, Jack & Heintz; E. R. Cunningham and R. D. Jones, General Electric; E. D. Berger, Air Associates; W. R. Beckerle, SAE; Chairman R. P. Loveland, General Electric; R. L. Anderson, Hertner Electric; S. L. Moore, General Electric; S. H. Vogt, Bureau of Aeronautics; P. Hubay, U. S. Electric Motors; R. K. Ericson, Barber-Colman Co.; G. Scherer, Wright-Patterson Air Development Center; W. K. Stubbs, Lear; C. G. Martin, Jack & Heintz; M. DeAdamo, Bendix Aviation; J. H. Redmond, Pesco. Not present for picture were F. N. Hines, Westinghouse and G. L. Hoddy, Universal Electric.

Shot Peening Group Holds 3-Day Meeting

DIVISION XX-Shot Peening held its annual three-day meeting at Hershey, Pa., Sept. 30–Oct. 2.

Four subcommittees met the first day. They were the Test Strip Subcommittee, J. C. Straub, chairman; Shot Quality Testing Subcommittee, N. S. Mosher, chairman; Coverage Subcommittee, R. H. Briggs, chairman; Blast Cleaning Manual Subcommittee, Fred Bush, chairman.

On the second day of the meeting, four technical papers were presented. They were:

"The Effect of Temperature on the Endurance Limit and Relaxation of Spring Materials" by F. P. Zimmerli of Barnes-Gibson-Raymond and Prof. W. P. Wood of the University of Michigan

"The Nature of Fatigue Weakness in Metals" by Prof. T. J. Dolan of the University of Illinois

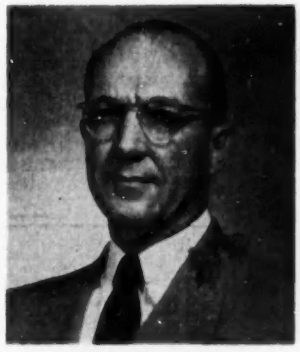
"Shot Peening Problems and Applications in the Aircraft Industry" by H. J. Noble of Pratt & Whitney Aircraft

"Effect of Shot Peening Variables on Life of Leaf Springs" by R. L. Mattson and W. S. Coleman of General Motors Research Laboratories

Division members put aside technical matters Thursday evening to en-

Headed for ISO Meet in Spain

J. H. Hunt



V. J. Roper

SAE Past-President J. H. Hunt and V. J. Roper, General Electric Co., will represent the United States at the meeting this month of the Illuminating and Indicating Lights Section, Technical Committee 22 on Automobiles, of the International Standards Organization. The meeting will be held in Madrid, November 16–21. The meeting agenda will cover such items as photometric and colorometric specifications for indicating lights, back-up lights, and terminal voltages.

Rittenhouse Takes CIMTC Reins

Euclid Road Machinery's H. L. Rittenhouse (left) is the new chairman of the Steering Committee of the SAE Construction and Industrial Machinery Technical Committee. Elected to this post at the group's Sept. 15, Milwaukee meeting, Rittenhouse succeeds A. F. Meyer Jr. (right), of Heil Co., who was chairman for two years.

joy a dinner with their guests and an evening of entertainment. John "Houdini" Straub presided, and Ray Sackett spoke on "Atomic Blasted Automobiles or How to Lose Your Shirt in Las Vegas," based on the experiences of an SAE Committee. Slides and movies of previous Division XX meetings were shown.

F. P. Zimmerli, who has been named next chairman of Division XX-Shot Peening

At a business meeting held the final day of the meeting, F. P. Zimmerli, chief engineer of Associated Spring Corp.'s Barnes-Gibson-Raymond Division, was named to be next chairman of Division XX, which is a division of the SAE Iron and Steel Technical Committee.

Included in the reports subcommittee chairmen presented was the news that work on the Blast Cleaning Manual and the bibliography on shot and blast cleaning are about complete.

AMS Division Met Sept. 21-25 in Boston

AT the semi-annual meeting of the SAE Aeronautical Material Specifications Division held September 21-25 in Boston, 111 Division members and interested suppliers considered 155 new and revised AMS's. Officers were reaffirmed, and policy on accessories materials decided.

The AMS's were discussed in one- or two-day sessions of each of the five Commodity Committees. The actions taken by the appropriate Committee were reported in combined sessions of the whole Division on Wednesday and Friday afternoons.

J. B. Johnson was nominated to serve again as AMS Division chairman for the coming year. Commodity Committee officers reaffirmed were:

Finishes, Processes, and Fluids
W. C. Schulte, Chairman
R. R. Gutteridge, Secretary

Non-Metallic Materials
C. M. Miller, Chairman
F. R. Kostoch, Secretary

Non-Ferrous Alloys
L. D. Bonham, Chairman
G. F. Kappelt, Secretary

Carbon and Low-Alloy Steels, and Titanium
Paul Mozley, Chairman
C. E. Carrigan, Secretary

Corrosion and Heat-Resistant Alloys
J. C. Mertz, Chairman
R. E. Pelzel, Vice Chairman
H. Brown, Secretary

Discussion of AMS usage by accessories manufacturers resulted in the decision to undertake development of AMS's for accessories materials used by two or more manufacturers.

After the combined session on Wednesday, the Wyman-Gordon Company showed the group through the company's new forge plant at Grafton, Mass.

Lawn Mower Couplings May Be Standardized

SAE will soon set up under the Engine Committee a subcommittee to undertake standardization of the engine coupling of vertical shaft, rotary lawn mowers.

This move was recommended by a group appointed by SAE Engine Committee Sponsor W. M. Walworth and Chairman H. W. White to study need for standardization of small aircooled engines. The group included Peter Altman, of Continental Motors Corp., who suggested the subject; K. Agar of Clinton Machine Co.; H. S. Brown of Briggs & Stratton Corp.; F. B. Esty of Wisconsin Motor Corp.; and P. H. Rosenberg of Reo Motors Corp.

The group felt that it might be worth while later for the subcommittee to work on standards for items such as carburetor flanges, magneto flanges, and engine mounts. Their idea was that standardization of engine external dimensions would make it easier for customers to procure spare parts and would cut down on the inventories distributors need carry.

Tractor-Drawn Implements Slated to Get More Versatile and Safer Lighting Systems

B. G. Van Zee, Minneapolis-Moline Co.

Based on paper "Report of the Tractor and Implement Safety Lighting Program" presented at SAE National Tractor Meeting, Milwaukee, Sept. 16, 1953.

SINCE the SAE Tractor Lighting Subcommittee was formed in January, 1950, to work with the Farm Equipment Institute Lighting Committee on farm machinery lighting problems, it has:

- Developed a standard electrical breakaway connector for farm tractors.
- Determined that a telescoping staff lamp or an extension-cord lamp will provide safe night lighting of tractor-drawn implements on the highway.
- Done preliminary work on a proposed standard mounting bracket for extension-cord lamps.

Development of a standard breakaway connector for tractor lighting systems proved to be one of the easier parts of our program to provide a safe, interchangeable, highway lighting system for tractor-drawn implements. (Fig. 1 shows the resultant SAE standard for an electrical breakaway connector.)

The requirement that light be visible 500 ft to the front and to the rear—and that the general outline of the drawn implement be visible to oncoming motorists—was not so easy to solve.

The mounting of a lamp or lamps on the rear of all drawn implements would, we knew, be very costly. And since many implements would never be drawn on the highway at night, it was proposed that this lamp or lamps be an attachment which could be carried on the tractor.

Next problem was what to do with all the extension wire when short-coupled machines were used. It was suggested that a telescoping staff lamp might be the answer. Mounted on the tractor as high as possible, this lamp could be extended out to the left to indicate the left-hand side of the implement. (See Fig. 2.)

This looked like a step in the right direction. But this type of lighting did not meet with approval in the then existing motor vehicle law. Therefore, we decided to ask the National Committee on Uniform Traffic Laws and Ordinances for permission to use it on farm equipment. As a result of this request, Act 5, Uniform Act Regulating Traffic on Highways, Section 137 was revised to read as follows: Sec. 137 Lamps on other vehicles and equipment—

(a) All vehicles, including animal-drawn vehicles and including those referred to in section 123 (c) not specifically required by the provisions of this article to be equipped with lamps, shall at all times specified in section 124 hereof be equipped with at least one lighted lamp or lantern exhibiting a white light visible from a distance of 500 ft to the front of such vehicle and with a lamp or lantern exhibiting a red light visible from a distance of 500 ft to the rear.

(b) Every farm tractor not equipped with an electric lighting system shall at all times mentioned in section 124 be equipped with lamps or lanterns meeting the requirements of paragraph (a) above. Every farm tractor equipped with an electric lighting sys-

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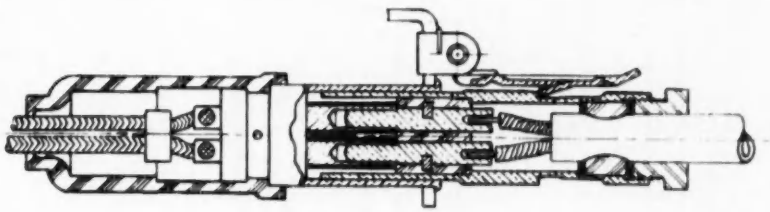


Fig. 1—SAE standard breakaway electrical connector for farm tractors. Besides its "breakaway" feature, this connector has a self-sealing cover on the female half, a seal that keeps dust and moisture away from the electrical connection inside the male half, and provision for torsional strain relief

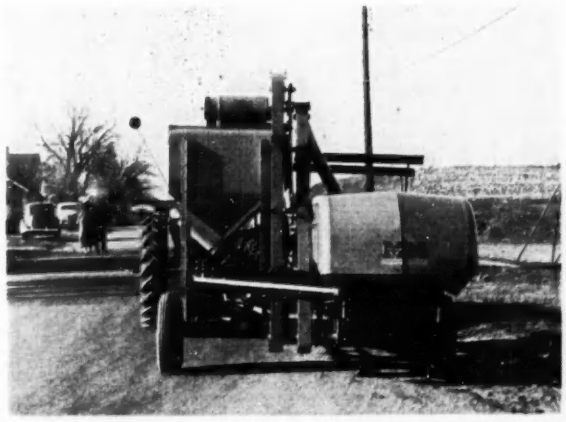


Fig. 2—This shows how a telescoping staff lamp can be used to indicate the left-hand side of tractor-drawn implements

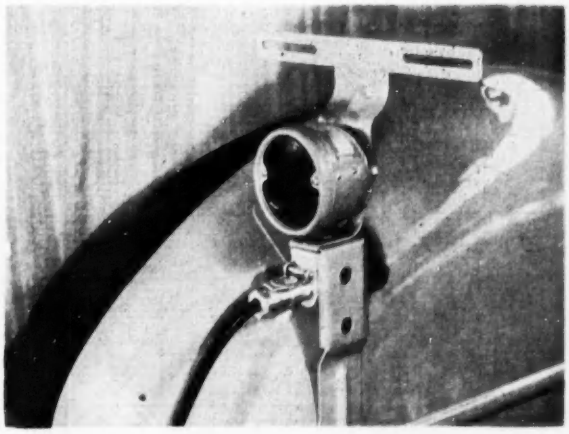
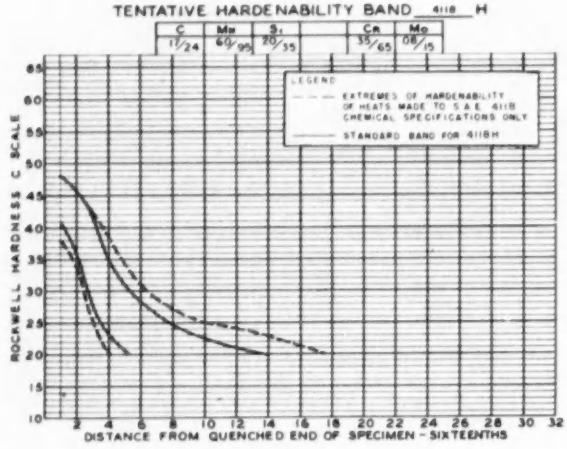


Fig. 3—Breakaway connector mounted on a tractor

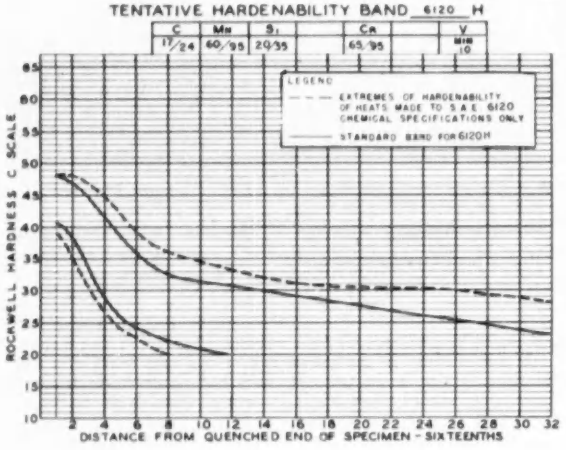
H-Bands Issued for 9 New Steel Grades;

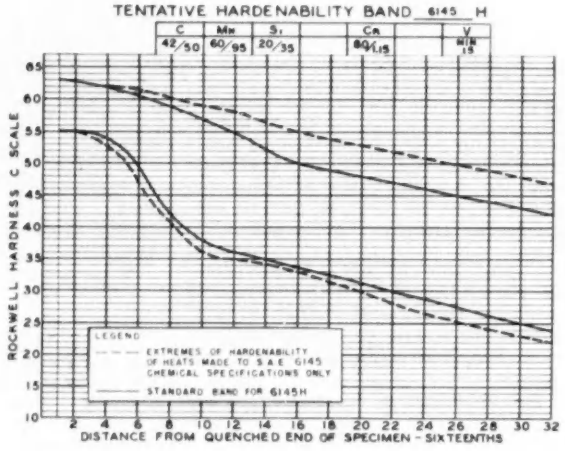


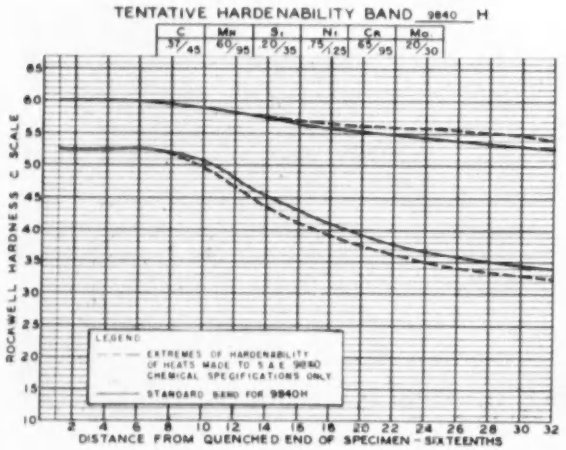
HARDENABILITY bands for five new SAE-AISI standard grades of steel and four new AISI tentative standard grades have been published by the American Iron and Steel Institute. These bands are the result of joint effort by the AISI and the SAE Iron and Steel Technical Committee.

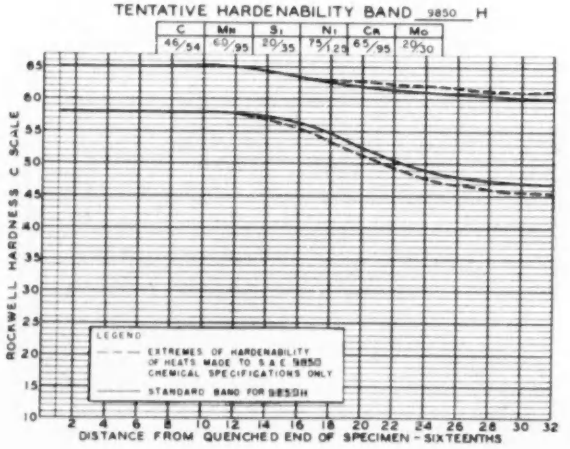
The new standard grades are **4118 H, 6120 H, 6145 H, 9840 H, and 9850 H.** The new tentative standard grades are **TS 4720 H, TS 8122 H, TS 40B37 H, and TS 51B60 H.** Two other grades, **6150 H** and **TS 81B40 H**, have been revised.

The hardenability band charts are reproduced herewith. The charts for the standard steels will appear in the next edition of **SAE Handbook**, along with tabulations of the hardenability values and of chemical compositions. The data on both standard and tentative standard steels are available from the American Iron and Steel Institute, 350 Fifth Avenue, New York, N. Y.

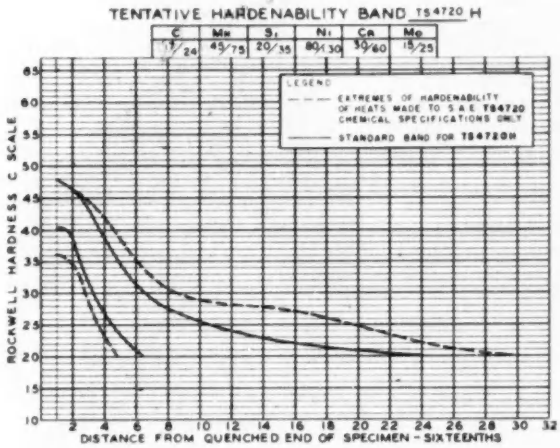


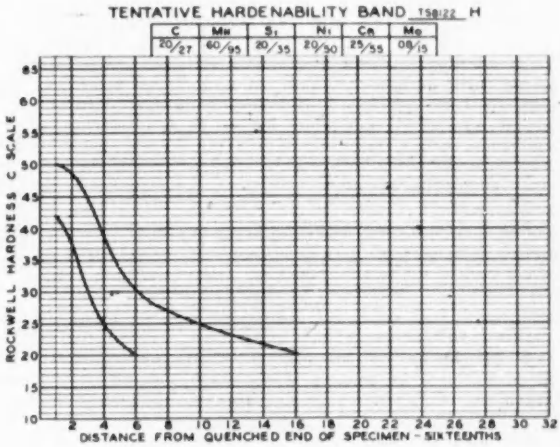


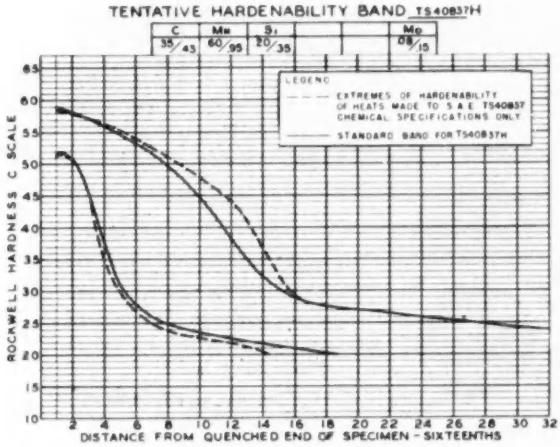


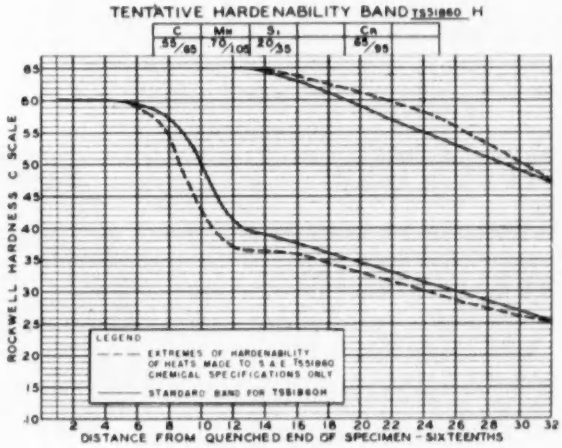


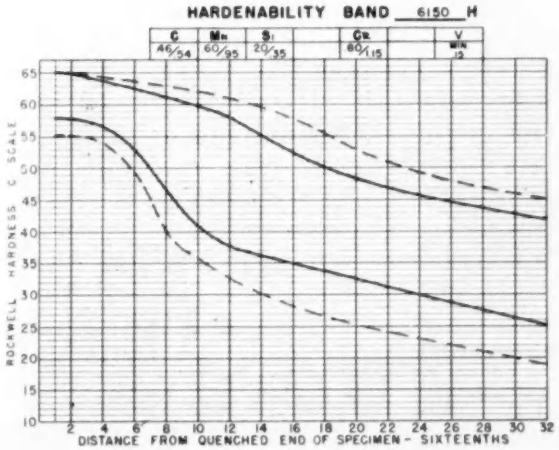
Bands Revised for 6150 H and TS 81B40 H

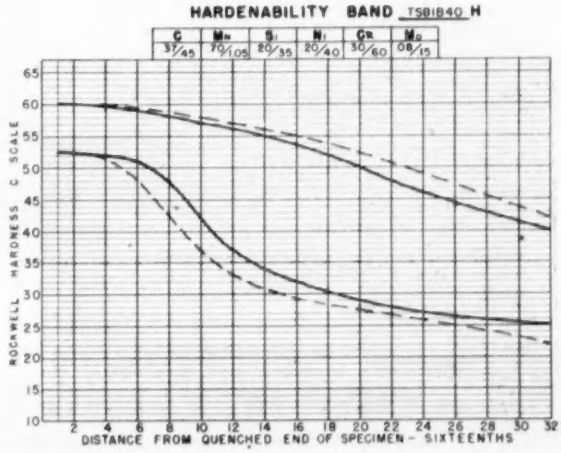












Continued from Page 95

tem shall at all times mentioned in section 124 display a red tail lamp and either multiple-beam or single-beam headlamps meeting the requirements of sections 126, 141, and 143 respectively.

(c) All combinations of tractors and towed farm equipment shall, in addition to the lighting equipment required by paragraph (b) above, be equipped with a lamp or lamps displaying a white or amber light visible from a distance of 500 ft to the front and a red light visible from a distance of 500 ft to the rear, and said lamp or lamps shall be installed or capable of being positioned so that visibility from the rear is not obstructed by the towed equipment and so as to indicate the furthest projection of said towed equipment on the side of the road used by other vehicles in passing such combinations. And further, all such towed farm equipment shall be equipped either with two tail lamps displaying a red light visible from a distance of 500 ft to the rear or two red reflectors visible from a distance of 50 to 500 ft to the rear when illuminated by the upper beam of headlamps, and the location of such lamps or reflectors shall be such as to indicate as nearly as practicable the extreme left and right rear projections of said towed equipment on the highway.

With the above revisions in the traffic code, we thought we were making good progress.

Field tests, however, showed that on certain machines, such as left-hand cut combines which extend to the left a considerable distance from the centerline of the tractor, the staff lamp did not fulfill the requirements of Section 137. It became apparent that a lamp with an extension cord would be required to protect certain machines. Thus, it was decided to leave the decision whether to use a staff or an extension-cord lamp up to the individual manufacturer.

Many tractor manufacturers are now supplying the socket part of the standard breakaway connector on various models of their tractors. (See Fig. 3.) And right now the committee is working on a proposed standard bracket for holding the extension-cord type lamp.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

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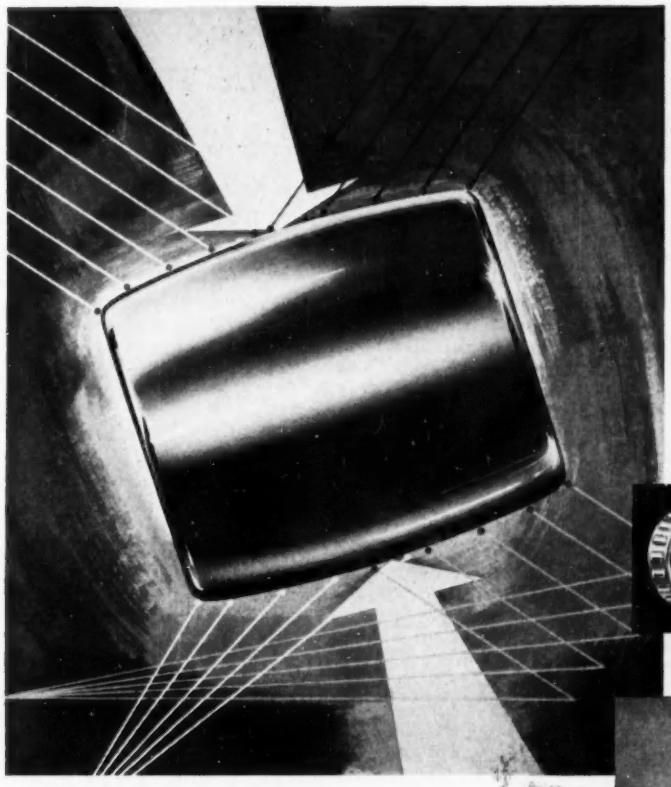

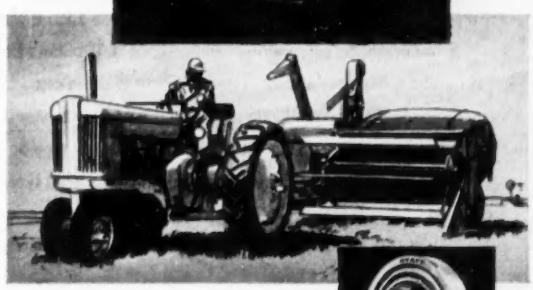

A new era in bearings is taking this shape...

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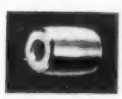
Industrial designers and engineers seldom make changes in bearing specifications. But when they discover something *really new*—like Hyatt's BARREL BEARING—out come the blueprints! *And this time they know they've got something!* Hyatt's new Barrel Bearing combines dual-purpose design with self-aligning action. It takes load from any direction and operates at full efficiency under conditions of misalignment! And, because barrel-shaped rollers provide high load capacity with low friction, this unique bearing is ideal for a wide range of applications. Best of all, the *cost* is far lower than you would expect! Find out how to improve *your* product . . . Consult a Hyatt Sales-Engineer, or write for our new Barrel Bearing catalog.



HYATT ROLLER BEARINGS

STRAIGHT · BARREL · TAPER

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Continued from Page 98

Revisions Under Way For Cable Terminals

THE SAE Standard on Cable Terminals is undergoing revision by the Subcommittee on Conduits, Cables, and Wiring of the SAE Electrical Equipment Committee.

So far the subcommittee has decided, at least tentatively, to consider the two ends of the terminal separately.

For the end that attaches to the binding post, changes in dimensions are under study for several sizes in the eyelet, spade, and end-type terminals in the current standard. Also under study is the possibility of adding a terminal size corresponding to the No. 12 screw size.

For the end that fastens to the cable, plans are to add descriptions of the crimped, soldered, swaged, and welded types, replacing the illustrations of the soldered-tab type in the standard as published in the 1953 SAE Handbook.

Next project for the subcommittee may be to devise a separate standard

1953 SAE Technical Board

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for friction-type terminals, which are not now covered by an SAE Standard.

R. H. Bertsche of GMC Truck & Coach is chairman of the subcommittee. Other members are: N. G. Bauer of International Harvester, F. E. Dresner of Packard Electric, J. W. Duhn of Chrysler, R. P. Kelly of Willys Motors, E. R. Olsen of Belden Mfg., C. J. Parker of Studebaker, C. W. Rainey of Ford, R. L. Simpkins of Essex Wire, F. H. Wetzel of Electric Auto-Lite, and A. E. Williams of Fruehauf Trailer.

CRC Releases Six New Reports

THE following Coordinating Research Council reports have been released for distribution and are available from SAE Special Publications Department, 29 West 39th Street, New York 18, N. Y. (This is a complete list of CRC reports released since publication of the listing of CRC reports on page 99 of the March, 1953, SAE Journal.)

Lubricants

Engine Oil

CRC-267—Investigation of Variables in Multi-Cylinder Oxidation Tests (5/52) Price $4.50 to SAE members; $9.00 to nonmembers.

Motor Fuels

Detonation—Full-Scale

CRC-268—Correlation of Road Anti-knock Ratings in Octane Requirement Survey Cars and Test Cars (9/52) Price .50 to SAE members; $1.00 to nonmembers.

Vapor Lock

CRC-269—Evaluation of the CRC V/L Apparatus (1/51) Price $1.50 to SAE members; $3.00 to nonmembers.

Aviation and Motor Fuels

Gasoline Additives

CRC-270—Temperature of Stored Gasoline 1943–1945 Desert Storage Tests on Motor and Aviation Gasoline (6/52) Price $2.00 to SAE members; $4.00 to nonmembers.

Aviation Fuels

Combustion

CRC-271—Relative Burning Velocities, Ignition Energies, and Quenching Distances for Twelve Fuels (3/53) Price .50 to SAE members; $1.00 to nonmembers.

Equipment and Motor Fuels

Engine Varnish and Sludge

CRC-272—Valve Burning (6/50) Price .50 to SAE members; $1.00 to nonmembers.

Students Enter Industry

Continued from Page 81

DONALD H. WEST (Oregon State College '53) has joined Weyerhaeuser Timber Co., North Bend, Oregon, as an engineering trainee.

LEONARD E. CHRISTOFERSON (Michigan College of Mining & Technology '53) is an engineering trainee with Caterpillar Tractor Co., Peoria, Ill.

RICHARD H. THOMAS (Case Institute of Technology '53) entered service in September. He was previously a trainee for Cleveland Graphite Bronze Co., Cleveland.

GEORGE S. VAVRA (Pennsylvania Military College '53) is a test engineer for Westinghouse Electric Corp., Lester, Pa.

HARRY E. STARR (Parks College of Aeronautical Technology '53) is a junior engineer with Bendix Aviation Corp., South Bend, Indiana.

GEORGE E. SWICK, JR. (Parks College of Aeronautical Technology '51) is a development engineer for the Aeroquip Corp., Jackson, Mich.

HOWARD W. CARR (Lafayette College '53) is a plant layout engineer for the Ternstedt Division of GMC, Trenton.

DAVID K. McKINLEY (California State Polytechnic College '53) is with Link-Belt Co. in San Francisco as an engineer.

CRAIG W. HARTSELL (University of Michigan '53) is with Marquardt Aircraft Co., Van Nuys, Calif., as an engineer.

ALAN B. WISSINGER (Carnegie Institute of Technology '53) has joined Sikorsky Aircraft Division, United Aircraft Corp., Bridgeport, Conn., as an analytical engineer.

PAUL A. STEIDEL (Academy of Aeronautics '53) is a jig and fixtures inspector at Republic Aviation Corp., Farmingdale, N. Y.

ALEX G. LAMPE, JR. (Academy of Aeronautics '53) is now at LaGuardia Field, New York, as instructor of a maintenance course.

JOSEPH A. JOHNSON (Purdue University '53) is a junior body development engineer in the styling section of GMC, Detroit.

WILLIAM A. McLAUGHLIN (Pennsylvania Military College '53) is a power plant engineer stationed at the Philadelphia Naval Base.

ANDREW J. RUDDELL (Academy of Aeronautics '53) is an instructor at the Casey Jones School of Aeronautics, Farmingdale, N. Y.

R. BUCK GRAY (Pennsylvania State College '53) is a sales engineer, Aluminum Co. of America, Pittsburgh.

JACK M. BRIDGES (Tri-State College '53) has joined the Allison Division of GMC, Indianapolis.

JAMES A. ACKER (University of Cincinnati '53) is with Chrysler Corp., New Castle, Indiana, as a tool engineer.

CARL E. COUSINEAU (University of Massachusetts '53) is at the graduate student training center of the Westinghouse Electric Corp., Pittsburgh, Pa.

WAYNE W. GRAUNKE (General Motors Institute '53) is a junior production engineer for GMC, Electro-Motive Division, LaGrange, Ill.

PETER G. SENCHUK (Northrop Aeronautical Institute '53) has joined Douglas Aircraft Co., Inc., El Segundo

Continued on Page 104

Students Enter Industry

continued

Division, Torrance, Calif., as a liaison engineer.

WILLIAM B. BAKER (University of Miami '53) is a supervisor in training, E. I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware.

PETER G. MEYERS (Pennsylvania State '53) has become a junior analytical engineer for Pratt & Whitney Aircraft Co., East Hartford, Conn.

NICK BARACOS (Lawrence Institute of Technology '53) is in the Mercury Division of Ford Motor Co., Detroit, as a project engineer.

ROBERT E. FISHER (Purdue '53) is now in the Oldsmobile Division, GMC, as a project engineer.

EUGENE J. PLEBAN (University of Detroit '53) is now a junior engineer at the Cleveland Pneumatic Tool Co., Cleveland.

PAUL E. BAXLEY (Clemson Agricultural College '53) has joined the Radio Corp. of America, Victor Division, in Camden, N. J. He is a mechanical engineer.

IRVING F. LIEBERMAN (Illinois Institute of Technology '53) has joined Zenith Radio Corp., Chicago. Lieberman is a mechanical engineer.

JOSEPH DORS (Indiana Technical College '53) has become an instructor at Indiana Tech.

MYLES R. BURNS (Utah State Agricultural College '52) now has his own auto repair business in Salt Lake City. Burns was previously in the U. S. Army.

CHARLES E. NORRIS (University of Pittsburgh '53) is in the Air Brake Division of Westinghouse Air Brake Co., Wilmerding, Pa. He is a student in the pneumatic engineering apprentice class.

SANFORD S. ACKERMAN (University of Delaware '53) has joined Westinghouse Electric Corp., Aircraft Gas Turbine Division, Lester, Pa. He is a junior engineer.

JOHN S. LATTA (General Motors Institute '53) is a service representative for the Buick Motor Division of GMC in Portland, Oregon.

JOHN R. SECORD (General Motors Institute '53) is a stress and vibration analyst at Ford Motor Co., Dearborn, Mich.

NICK J. ITSINES (Academy of Aeronautics '53) is a tool inspector for Republic Aviation Corp., Farmingdale, N. Y.

RALPH W. VAN DEMARK (Princeton University '51) is at Chrysler Corp. in Highland Park, Mich., as a staff engineer-junior.

GEORGE F. REITMEIER, JR. (Rensselaer Polytechnic Institute '53) is with Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y., as a research engineer.

LeROY B. THOMPSON (Carnegie Institute of Technology '51) is a graduate student trainee for Westinghouse Electric Corp., Pittsburgh, Pa.

JACK K. GILBERT (Oklahoma Agricultural & Mechanical College '50) is an industrial engineer for Collins Radio Co., Dallas, Texas.

CHARLES E. SHIELDS (University of Pittsburgh '51) is an engineer for Syntron Co., Homer City, Pa.

VINCENT D. FRANGER (San Diego State College '53) is now at the engi-

Continued on Page 106

After 199,000 miles of service... fleet owner reports "no appreciable wear" on Ni-Resist armored ring band pistons used in Buda Model 844 heavy duty engine. This user, operating 738 Diesel powered freight trucks and trailers in mountainous territory, expects considerably more mileage before replacing pistons of this type.

After 41,078 miles... the top ring groove failed in this conventional-type aluminum piston. Records shown distinct improvements attained by use of armored ring bands of Ni-Resist. Ni-Resist ring bands become an integral part of pistons when bonded to the aluminum alloy by the A1-Fin process, developed by FAIRCHILD ENGINE AND AIRPLANE CORPORATION.

5 times the mileage with Ni-Resist* ring grooves

A large fleet owner, operating gasoline engine powered trucks and trailers in the Rocky Mountain area averages 250,000 miles per set of aluminum pistons with bonded-in Ni-Resist® ring bands.

This is a typical performance, as shown by numerous reports reaching UNITED ENGINE & MACHINE COMPANY, San Leandro, California, a pioneer in producing Ni-Resist armored ring band pistons, sold under the trade-name DUALOY.

Some of these bi-metallic pistons are now in their third 250,000 mile operating runs after being twice reground to the next smaller oversize.

Use of Ni-Resist eliminates ring groove wear troubles. Accordingly, it helps to prevent blow-by and reduces oil consumption. In addition, it resists corrosive attacks from chemically treated fuels. Maximum piston life made possible by using Ni-Resist ring bands results in additional profit from increased mileage between overhauls... and substantial reduction of downtime expense.

Ni-Resist is specified because it combines outstanding resistance to heat, corrosion, metal-to-metal wear and galling. Equally important is the high thermal expansion of Ni-Resist Type 1 which nearly matches that of the aluminum piston alloy.

Other established Ni-Resist engine applications are cylinder liners, valve guides and exhaust system parts.

Investigate Ni-Resist for original equipment parts when designing new heavy duty engines — also for any problems involving corrosion, wear, heat and other destructive forces. We'll gladly supply you with information on the varied uses and types of Ni-Resist.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

** No other cast metal provides such a useful combination of engineering properties.*

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. SAE J-11-53

Dept. 20, 67 Wall Street, New York 5, N. Y.

Please send me booklets entitled, "Engineering Properties and Applications of Ni-Resist," and, "Buyers' Guide for Ni-Resist Castings."

Name_____ Title_____

Company_____ Address_____

City_____ State_____

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

Students Enter Industry

continued

neering test lab. of Dalmo Victor Co., San Carlos, Calif.

DONALD D. NELSON (Chrysler Institute '54) is with Chrysler Corp., Highland Park, Mich., as a student engineer.

ROBERT J. MACK (General Motors Institute '53) will enter the U.S. Navy this month.

ERNEST J. HAAS (Columbia University '55) is a production test facilities engineer for the Wright Aeronautical Division of the Curtiss-Wright Corp., Wood-Ridge, N. J.

THOMAS L. COOKE (Case Institute of Technology '53) is an operations engineering trainee for the East Ohio Gas Co., Cleveland.

JAMES CSAPOSS (Stevens Institute of Technology '53) is now a second lieutenant in the U. S. Air Force.

WALTER F. WOOD (General Motors Institute '53) has joined GMC in Framingham, Mass. Wood is a process engineer.

JOHN A. LIPPINCOTT (Parks College of Aeronautical Technology '51) is a lieutenant in the U. S. Air Force. He is stationed at Reese Air Force Base, Lubbock, Texas.

HERBERT N. UNDERWOOD (Illinois Institute of Technology '53) is at the Borg-Warner central research laboratory, Bellwood, Ill. He is a research engineer.

STEPHEN FLORKEWICZ (Stevens Institute of Technology '53) is in the Aeronautical Division of Curtiss-Wright, Wood-Ridge, N. J., as a test engineer.

MARVIN P. McCOLLUM (West Coast University '53) is a mechanical engineer for the Hufford Machine Works, El Segundo, Calif.

GEORGE E. MAHLMEISTER, JR. (General Motors Institute '53) is a plant layout engineer for the Detroit Transmission Division, GMC, Willow Run, Mich.

DONALD M. CLANCY (Northrop Aeronautical Institute '53) is with Douglas Aircraft Co., Santa Monica, Calif. He is a flight test analyzer "A."

JOHN E. FAHLGREN (Chrysler Institute '53) is with Chrysler at Chelsea, Mich., as a test and development engineer.

EDSEL A. SPELLMAN (Indiana Technical College '53) is now doing layout and design work for Power Generators, Ltd., Trenton, N. J.

CLAYTON E. WELLS (Northrop Aeronautical Institute '53) has joined North American Aviation, Inc., Los Angeles, as a draftsman.

R. B. PIPER (University of New Hampshire '53) is with the International Business Machines Corp. in Poughkeepsie, N. Y. Piper is a general manufacturing trainee.

RALPH KERSTNER (Northrop Aeronautical Institute '53) is a junior engineer draftsman "A" at Northrop Aircraft, Inc., Hawthorne, Calif.

EUGENE C. COAN (Oregon State College '53) is assistant to the master mechanic of the Great Northern Railway, Superior, Wis.

JESSE G. FORSYTHE, JR. (Swarthmore College '53) is an engineer "A" with the Westinghouse Electric Co., Aviation Gas Turbine Division, Lester, Pa.

Students Enter Industry

continued

WILLSON P. BRUMBACK, JR. (Northwestern Technological Institute '53) is with Thompson Products, Inc., Cleveland, as a test engineer.

HAMILTON A. MEYERS (Northrop Aeronautical Institute '53) is with North American Aviation, Inc. at the International Airport, Los Angeles. He is a draftsman "A."

ROY S. MURPHY (Northrop Aeronautical Institute '53) is an engineering draftsman "A" for North American Aviation, Inc., at Downey, Calif.

DAVID J. HAYKIN, JR. (Purdue University '53) is a lieutenant in the U. S. Air Force. A radar officer in training, Haykin is stationed at Keesler Air Force Base, Miss.

CHARLES M. MOREAUX (University of Minnesota '53) is now a junior research engineer with Lockheed Aircraft Corp., Burbank, Calif.

WALTER J. KLINE (Oklahoma Agricultural and Mechanical College '53) is a junior service engineer with Dowell, Inc., Houma, La.

ROBERT P. FORELLA (General Motors Institute '53) has joined the Chevrolet-Flint Mfg. Division of GMC, Flint, Mich., as a test engineer.

CARL ALAN SCHORKEN (University of California '53) is now a junior design engineer with Northrop Aircraft Inc., Hawthorne, Calif.

ALBERT J. IMPINK, JR. (Villanova '53) is a mechanical engineer with the Sandia Corp., Albuquerque, New Mexico.

LUTHER GLENN RADER, JR. (Agricultural and Mechanical College of Texas '53) is a petroleum engineering trainee with the British American Oil Producing Co., Riverton, Wyoming.

PAUL A. HOOVER (University of Cincinnati '52) is at Frankford Arsenal, Philadelphia, in the Ordnance Corps as engineering research assistant.

RICHARD D. SMITH (Lawrence Institute of Technology '53) is in the U. S. Army, Third Army Division, Fort Knox, Ky.

CHARLES F. OSTNER (Purdue University '53) is in the U. S. Army, Fort Bragg, N. C., as a gunnery test officer.

MATHEW D. GARRED, JR. (Purdue '53) is an experimental test stand engineer in the Allison Division of GMC, Indianapolis.

DONALD S. SAMMIS, JR. (University of Colorado) is a lieutenant stationed at Lowry Air Force Base, Denver.

Continued from page 86

similar speed range. Therefore, compactness, high rotational speeds and low cost represent the lines of development.

Unless outstanding advantages are to be gained, which seems unlikely, the use of either air-cooled or two-cycle engines appears to be unjustified, since both are likely to require substantial departures from the basic gasoline engine chassis. The air-cooled engine is less compact than the equivalent water-cooled engine, and the two-cycle engine would require a different transmission to handle the higher torque and lower maximum speed.

With the trend toward smaller sizes and higher speeds, it appears safe to predict that in the next few years we shall see an increasing use of diesels in small trucks and passenger cars, with the water-cooled in-line four-cycle engine having a swirl type combustion chamber as the predominant type. (Paper "The Small Automotive Diesel Engine in Great Britain and Europe" was presented at SAE International West Coast Meeting, Vancouver, B. C., Aug. 18, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Investigates Air As Bearing Lubricant

Based on paper by

DAVID K. McKINLEY

California State Polytechnic College

THE tapered film of lubricant is the secret of success of a sliding surface bearing by virtue of which it attains its capacity, low coefficient of friction, and wear resistance. There is much experimental information and there are many empirical formulas suitable for design needs to get thick-film lubrication with a minimum power loss when the lubricant is a petroleum product. But what happens with a very low-viscosity lubricant such as water, air or other gases?

To determine if data and theory are still applicable, a Kingsbury thrust bearing was chosen as most desirable for test with air as a lubricant. The asembly of parts was given considerable attention to ensure proper alignment of the six shaft bearings and that all parts were absolutely free of dirt, oil, and moisture.

The bearings were started under a very light load. As the shaft came up to the speed set by the rheostat, the noise level of metal parts rubbing decreased. At approximately equilib-

rium speed two shoes of each bearing commenced to "flutter" and rock; the noise level further decreased. An attempt was made to check the rpm by strobotac, but as it was being adjusted the noise level began to increase and rpm to decrease simultaneously. As the rpm decreased more rapidly the test was terminated. The maximum speed was approximately 1600 to 1700 rpm. Duration of the run was about 10 sec.

Upon inspection it was found that all shoes were badly scored and the collars slightly scored. It is concluded from the test that the surface finish was not sufficiently fine. In general, it can be said that the finer the surface finish the smaller the required minimum film thickness. (Paper "Investigation of a Kingsbury Thrust Bearing Using Air as the Lubricant" was the winner of the Mac Short Memorial Award presented by SAE Southern California Section, April 13, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Off-Highway Hauling Needs Cost Reduction

Based on paper by

R. C. KEAST

Hayes Mfg. Co., Ltd.

THE need to penetrate farther into the hills for timber and deeper into the earth for minerals has intensified the demands placed on motor vehicles. As a result, the cost per board foot or ton mile has mounted to the point where utmost economy in vehicle operation has become imperative.

An adequate maintenance program can help reduce hauling costs and with such a program some operators claim a 50% saving in maintenance cost and a 100% improvement in employee-management relations.

Each operator must determine the best time for his particular vehicle inspection; some tend to overmaintain, others let wear and maladjustments go too long. The time for performing anticipatory repairs can be determined only when adequate maintenance records are kept. Fuel consumed as well as miles travelled can provide a basis for a maintenance schedule. Faber tests of crankcase contaminants are often used as a guide to engine adjustments of parts replacement. (Paper "Preventive Maintenance of Off-Highway Vehicles" was presented at SAE International West Coast Meeting, Vancouver, B. C., August 17, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

New Members Qualified

These applicants qualified for admission to the Society between Sept. 10, 1953 and Oct. 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

Tommy Eugene Adams (J).

Baltimore Section

Milton D. Behrens (J), C. David Haacke (J), James Clinton Hussong (M).

British Columbia Group

G. L. Creighton (M).

Buffalo Section

John O. Archibald, Jr. (J), Robert N. Cruser (M), Willard O. Emmons (M), William H. Gratz (J), Milton B. Punnett (J).

Canadian Section

Alfred Benton Blythe (M), John W. Brown (A), John Edward Carney (A), Wallace J. Kribs (A), Charles Allan Milton (A), Maurice Hampton Satchell (J), Donald Stevens Wood (A).

Central Illinois Section

Howard R. Moos (J).

Chicago Section

Robert W. Allen (A), Howard Eugene Chana (J), Earl L. English (A), John Bruce Ingold (J), Harry Lucas (A), William L. McNulty (J), Jack B. Phelps (A), Elling H. Runden, Jr. (M), George Edgar Stanton, Jr. (J), William L. Steinhoff (J).

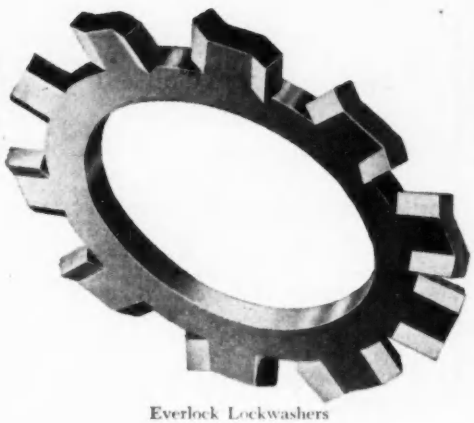
Cincinnati Section

Peter G. Belitsos (M), J. Donald Cleavinger (J), Martin C. Hemsworth (M), Harry J. Kent (J).

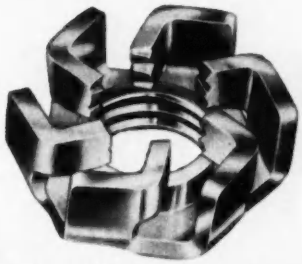
Cleveland Section

David Bebb Albrecht (J), D. C. Aldrich (A), Richard Clark Baubles (J),

Continued on Page 112



Everlock Lockwashers



New "Spin-Down" Locknuts

Everlock Screw & Lockwasher Assemblies

Everlock Terminals

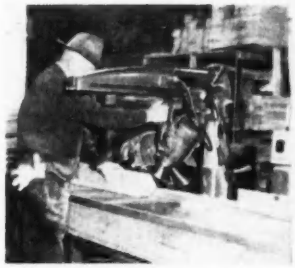
AMF EVERLOCK* FASTENERS

...on in an instant—to stay a lifetime

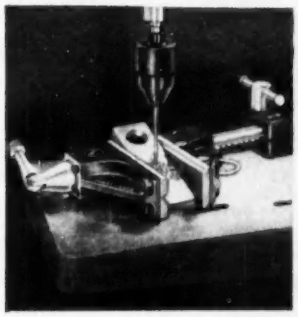
Automotive assemblies stay securely held in the grip of AMF Everlock "Chisel Edge" Lock Washers. Made by AMF Subsidiary, Thompson-Bremer & Company, these double-edge, multiple-bite washers have successfully fought vibration in millions of passenger and commercial vehicles.

Newest member of the Thompson-Bremer family is the AMF Everlock Locknut. This one-piece, all-metal nut spins down finger-free, locks securely with a twist of a wrench or power tool. This new fastening development is another example of how AMF products help the automotive industry. The Everlock Locknut effects savings in purchasing, handling and speed of assembly. Other AMF products are illustrated below. Your inquiries are invited. Address AMERICAN MACHINE & FOUNDRY CO., General Products Group, 511 Fifth Avenue, New York 17, N. Y.

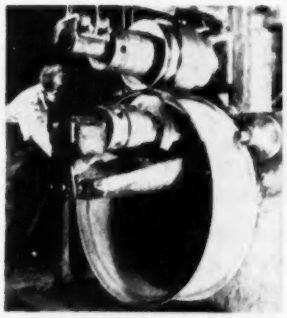
Detroit Representative: Mr. Sam Keller, 2457 Woodward Avenue, Detroit, Mich.



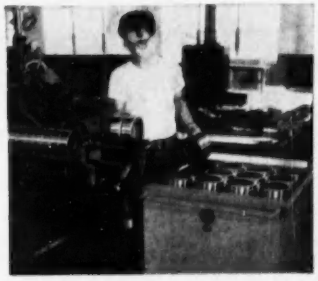
SHIPPING AND MAINTENANCE departments find AMF De Walt* Power Saws save time in all wood-cutting operations.



AMF WAHLSTROM* Fully-Automatic Chucks and AMF FLOAT-LOCK Instant-Change Safety Vises speed tool set-up changes.



MAJOR SUPPLIER of rims and circular weldments for the Automotive Industry is AMF's Cleveland Welding Company.



AMF INDUSTRIAL LOWERATOR* DISPENSERS store and position planned quantities of parts in process at efficient working levels.

AMF products ARE BETTER...by design

AMERICAN MACHINE & FOUNDRY COMPANY

*Registered Trademark

New Members Qualified

continued

Delmar E. Benjamin (J), Raymond R. Decker (J), Jack W. Dunbar (J), Don F. Harroff (J), Richard Stanley Kopchynski (J), Matthew Charles Kuepfer, II (J), William J. Kundrat (J), Albert J. Phillips (M), Robert Lewis Shaw (J), Philip Walter Skove (J), Walter Robert Tuuri (J), John Ivar Wahlstrom (J), Thomas Howard Wiggins (J).

Colorado Group

Richard P. Bobco (J), Larry N. Lynch (A), Alan Frederick Schmidt (J).

Dayton Section

Kenneth R. Durst (M), William A. Sponzilli (M), John A. Taylor (M).

Detroit Section

William G. Agnew (J), Robert H. Appleman (J), George L. Barker (A), Joseph Ferguson Bird (J), Charles Henry Boehm (J), Constant L. Bouchard (M), William J. Burke (M), Robert F. Busuttil (J), James A. Caulfield (M), Bernard A. Chapman (M), Daniel Chieger (M), Robert West Connor (A), John Zachary De Lorean (J), Leon N. DeVos (A), Tammo G. Drewes (A), Frank C. Druzynski (J), George R. Eckhoff (M), Donald L. Endicott (J), William James Eubank (J), Carlo C. Fulco (A), Martin J. Galli (J), Edward G. Goldstone (M), Victor J. Harris (J), Kenneth R. Hill (J), Joseph J. Hoffmann (A), Danforth Holley (A), Frank W. Hudson (M), Jimmie James (J), Sidney D. Jeffe (J), George N. Jenkins (M), Alger R. Johnson (J), Henry E. Kasner (J), Marden M. Kingman (A), Ralph E. Koldhoff (A), William Robert Konopacke (J), Donald Ferris Kopka (J), Frank A. Kunze (J), Donald J. LaBelle (M), Anthony J. Leonard (J), Douglas Fraser Millar (A), George William Niepoth (J), Stewart E. Norwood (A), Stanford Robert Ovshinsky (M), Vincent Louis Polkus (J), John James Rodgers (J), John F. Sieberth (J), Robert M. Sinclair (J), William Reid Smith (A), Ralph C. Stahman (J), Henry M. Stahl (M), Philip G. Stratton (J), Howard E. Strong (M), Raymond J. Symons (J), John C. Thrasher (M), Kenneth William Verge (J), Maurice M. Welsh (J), Louis A. Welt (A), Robert Kwoh-Tao Woo (J).

Hawaii Section

John Melville Ireton (A), Iwao Motonaga (A).

Indiana Section

George A. Campbell (M), Eugene Josef Geiger (J), James Richard

Continued on Page 115

New Members Qualified

continued

Hunter (J), Donald D. Kriplen (J), Frank Essa Nasser (J), Thomas Osorio Newby (J), Carl L. Nigh (J).

Kansas City Section

Truman Hall (A).

Metropolitan Section

Donal L. Botway (J), John Edmund Cammack (J), Frank J. Dooney (A), Robert J. Fandrey (A), Kenneth H. Fox (M), Harold Thomas Larkins (J), John Maranchik, Jr. (M), John T. Mealy (M), Ernest A. Weil (M), Rayner Colbourne Powell (J), Hiram Edward Searles (M), Edward P. Sullivan (J), T. Stanford Tutwiler (M), Marcus F. Warmuth (M), Joseph P. Yakal (M), Charles W. Yodzis (J), Elwood R. Zeek (M).

Mid-Continent Section

Charles Edwin Davis (J).

Mid-Michigan Section

Fred Jubera (J), Frank V. Klco (M), Philip C. Servais (M).

Milwaukee Section

Richard R. Bridge (J), Charles Featherly (M), Emil J. Granitz (J), Bob Korf (M), Douglas E. Peash (J), Lloyd Paul Post (M), Keith H. Rhodes (J), Paul Host Schmitt (J), Earl A. Ustruck (J).

Mohawk-Hudson Group

Sherman Crane Kent (J).

Montreal Section

Wesley E. Ball (A), Roland Plourde (J).

New England Section

Arun Prasad (J).

Northern Califorina Section

Alexander M. Plunkett (M), John Y. Wong (M).

Northwest Section

William G. Warner (J).

Oregon Section

Robert J. Hagelberger (A), James R. Montgomery (A), Gerald A. Schuler (J), James M. Springer (A), Stanley E. Watt (A), Wallace H. Yost (A).

Philadelphia Section

Ralph Orville Brunt (J), Albert V. Cabal (M), George G. Cudhea (M), Carson De Cash, Jr. (J), Kenneth A. Frassa (J), John Joseph Gricius (J), Charles Ponti (M), Frederick E. Seidel, Jr. (J).

Continued on Page 116

New Members Qualified

continued

Pittsburgh Section

David T. Rogers (M), Ross M. Stewart (M), James F. Wagner (M), William C. Weltman, Jr. (J).

St. Louis Section

Howard Feldman (J), John J. Steuby (J), John F. Wickey (J), William Elliot Williamson (M).

Salt Lake Group

Olonzo Adair (A).

San Diego Section

Henry Berlinghof, Jr. (M), Floyd Cox (M), Robert Charles Hinck (J), Kenneth K. Krull (M), Lawrence M. Limbach (M).

Southern California Section

Martin Sherman Blackman (J), Mario S. Bonura (J), Gerald A. Burmeister (J), George Rosel De Lay (A), Donald Bruce Epner (J), Richard S. Fairall (J), Alex Gonzalez (J), Elwyn Phillips Jordan (M), Robert Lawrence McKinnon (J), Luciano F. Molinari (J), George William Soto (J), Gordon Edward Saxon (J), Arnold E. Thompson (A), John A. Wagner (A).

Southern New England Section

Philip E. Ashton (M), Robert Baer (M), Richard F. Barbian (J), Robert James Black (J), Allen Edward Cable (J), Stanley L. Leavitt (J), Edward William Presbie (J).

Spokane Intermountain Section

Frederick J. Fleming (A), Lytle Richard Van Dusen (A).

Texas Section

James J. Gilchrist (J), Richmond W. Hathaway (J), Daniel H. Olsson (J).

Texas Gulf Section

Harris Saunders, Jr. (A).

Twin City Section

Alfreds Mucenieks (M).

Virginia Section

Ivan H. Cox (A).

Washington Section

J. Melvin Miller (M), 2nd Lt. George W. Stetson, III (J).

Western Michigan Section

Donald Bryan Sewell (J), L. A. Zahorsky (M).

Continued on Page 117

New Members Qualified

continued

Williamsport Group

Richard Elliott Wainerdi (J).

Outside Section Territory

Harry Brinkley Anderson (J), Bruce Melvin Bearden (J), Charles W. Cable (M), Michael Chucta (M), Norman F. Hosford (M), Lewis A. Montgomery, Jr. (M), Lt. (jg) Gerald David Olson (J), Albert Theodore Reiff, Jr. (J), Robert Vann Richards (A), David Merlin Schmitt (J), Anthony F. Solla (M), Robert Noel Stevenson (M), John K. Stull (M), Bryon C. Thomson (M).

Foreign

Harry Wilson (A), England; James E. C. Van Luppen (A), Belgium.

Applications Received

The applications for membership received between Sept. 10, 1953 and Oct. 10, 1953 are listed below.

Atlanta Group

James A. DeSana, Fred Flotron.

Baltimore Section

Calvin H. Cropper, Earl C. Hoffer, Herbert Harlie Lee.

Buffalo Section

William G. Cowdin, Donald I. Hall, Ernest R. McAdoo, Arthur Edmund Miller, Fred C. Pletzker.

Canadian Section

T. S. Adams, Eric Ronald Hilborn, Douglas Kirkaldy, Roderick D. Macdonald, Roderick J. McGregor, Edmund B. Niescior, John B. Rea, Robert Davies Shepherd.

Central Illinois Section

John M. Bailey, Cecil D. Beadles, Robert Lee Behrens, Leonard E. Christoferson, Joseph G. Fedor, Gerald Allen Jensen, Gustav G. Lindstrom, Edward L. Morris, John R. Rediger, Donald J. Tomasek, Lyle F. Yates.

Chicago Section

James Richard Bateman, William H. Beim, Charles Robert Bell, Donald L. Boyd, Charles M. Burlingham, Jr., Lester Frank Dasse, Devere Carl Dick-

Continued on Page 118

Applications Received

continued

erson, Roger Kenneth Ericson, Norman Dean Esau, F. Daniel Griswold, Irving H. Hallberg, Harry G. Liljeblad, Donald A. Malohn, Arthur C. Olfs, Jr., Robert J. Outland, Richard W. Pence, Thomas Arthur Racine, Ralph A. Schlarb, Clayton M. Shepstone, Frank M. Treffil.

Cincinnati Section

James S. Wilson.

Cleveland Section

Theron J. Baker, William Carter, William M. Day, Jimmie W. DeMoss, Allen E. Dreman, Harold W. Goodknight, Jr., Dale C. Greig, Raymond Herman, David G. King, James L. Laws, Robert R. Markgraf, Paul Misencik, Jr., Paul C. Rector, Raymond E. Richards, Ralph Lewis Sabiers, Jr., William F. Saefkow, Hugh Thurnauer, William G. Wallace.

Colorado Group

Gene S. Lofgren.

Dayton Section

Wayne George Blystone, Richard L. Carmon, T. R. Dick, Howard T. Spelman, Eugene Edward Young.

Detroit Section

James F. Albrecht, Herbert H. Alvord, Richard Bliss Armstrong, William A. Armstrong, Harold J. Barber, Robert J. Bayer, Robert William Beaupre, Robert P. Benzinger, Frederic W. Brede, Jr., Sherman Louis Bremer, Donald E. Brodeur, William Hunter Brown, Edwin K. Buyze, Phillip E. Chase, Warren W. Coleman, Raymond C. Collins, Roger G. Crete, Benjamin G. Davis, Omer C. DeClercq, George Venner Derisley, William L. Doerr, Bill Duffy, C. A. Ebersole, Norbert J. Ernat, Walter Kimball Fales, Raymond George Falzon, George J. Fischer, William Fournier, Harold W. Foddy, Jr., Edward A. Fosler, H. Wayne French, Nolan Joseph Fugazzi, Thomas J. Galbreath, John Howard Gebo, Donald H. Gill, Hubert T. Graether, Benjamin Gratz, William Henry Graumlich, Dwight M. Hayne, William P. Hazel, Robert W. Hebel, Cecil J. Heiden, Paul Victor Heron, F. John Herrington, Jr., Howard James Hildenbrand, Jack F. Hockman, Robert L. Hoenk, Walter Richard Holm, R. Brian Honeyball, Douglas Hughson, Joseph J. Ihnacik, Jr., William D. Innes, John B. Jackson, Jr., Richard P. James, Dale Robert Johnson, Kalin S. Johnson, John E. Kennelly, Michael H. Kleinman, Walter A. Kosztowny, Allen M. Krass, Leonard LaBuda, James H. Lagergren, Thomas A. Landis, Clarence B. Lawrence, Peter

Continued on Page 119

Applications Received

continued

B. Loomis, Douglas C. Lyall, John A. Main, William Martin, Edward B. Mazzotta, Warren H. McAfee, William Melnyk, Carl J. Miller, Robert D. Mitchell, Bruce W. Mitton, Richard D. Moan, John A. Mowbray, Robert Leo Nagel, Richard J. Nuffer, Larus J. O'Brien, Tollef Lintrup Paus, Earl N. Pearson, Harvey Raymond Pickford, James John Poledna, Fred M. Rose, Michael Rasich, H. Conrad Sonderegger, George F. Stirrat, Donald R. Skidmore, James F. Sabiston, George R. Ryder, Jr., Edmond J. Ray, Dale A. Randall, William F. Repovz, Charles Robert Rutherford, Raymond J. Ribant, Albert Walter Ratush, R. C. Sandburg, John Dewey Schultz, Robert E. Seelye, George William Sheardown, Earl W. Sheedy, Robert S. Sholtes, Richard W. Sinko, Tracy W. Smith, William R. Spence, John Worley Stafford, Howard A. Stalz, Carl Donald Taulbee, Robert C. Taylor, John Townsend Thode, Henry Tischler, Harold Von Bergen, Robert Morton Wagner, Raymond Walker, Fred J. Warrell, Richard B. Watson, Michael Waypa, Jr., Joseph T. Wentworth, Gordon Ellis Whelpley, Floyd A. Wyczalek, Robert V. Yazejian.

Hawaii Section

Fred Y. Fujimoto, Gabriel K. M. Lau.

Indiana Section

Wallace E. Graham, James V. Harrison, Harold Peter Horwitz, James Lester Knearem, Kearney K. Kozai, C. A. Lindblom, Jr., James W. McKinney, John H. Murphy.

Kansas City Section

John E. Davidson, Jr., Henry E. Hutchings, Harold John Snyder, Jr.

Metropolitan Section

Robert P. Bowler, Peter J. Caruso, George Clarke, Harold David Connelly, Frank Paul Dicuia, Roger T. Ellis, Percy E. Mizelle, C. W. Nichols, Jr., Leo Peters, Norman S. Rice, John George Rueppel, Joseph C. Ryan, Ralph R. Smorkaloff, Edgar Kenneth Stewart, Jerome Strange, Willis H. Taylor.

Mid-Continent Section

Charlie F. Loftin, Jr.

Mid-Michigan Section

Richard R. Bey, Roy Warren Bloch, Robert H. Daley, Jack L. Gockel, Richard E. Halatek, Bruce Melvin Kemppainen, Thomas R. Leonard, E. G. Lill, Walter F. Long, Ralph A. Malone, Robert A. Mooney, Jr., Arthur

Continued on Page 120

Applications Received

continued

J. Scaife, Bruce W. Smith, Robert J. Stiehl, Charles M. Strachan, John G. Zelenka.

Milwaukee Section

Eric H. Dodge, John H. Fellows, Omar Hansen, Jr., Floyd W. Johnson, B. L. Loungren, Warren D. Nutten, Rufus K. Schriber, Jr., John Eugene Wieschel, James R. Wynne.

Montreal Section

W. D. Dawson.

New England Section

Arthur J. Clark, Joseph Henry Valentine.

Northern California Section

James Francis Berry, James E. Conner, Robert H. Duensing, Sr., Rick V. Espinasa, Curtis L. Fent, William C. Keil, Joseph William Menconi, William H. Moranda, Frederick Warren Ranke, R. Roy Taboada, Hollis R. Williams.

Northwest Section

William D. Cordz, Mark Edwin Kirchner, Otto E. Kirchner, Jr., Lloyd J. Thurston, Phil Wallingford, Sanford E. Webb.

Oregon Section

Raymond J. Seelie.

Philadelphia Section

Daniel J. Grady, Byrd F. Parmelee, Gene F. Pierson, Oliver A. Sprague.

Pittsburgh Section

Charles Gilbert Slater.

St. Louis Section

Elijah P. Cunningham, Don W. Morrison, James Dennison Truesdale, Charles O. Traylor.

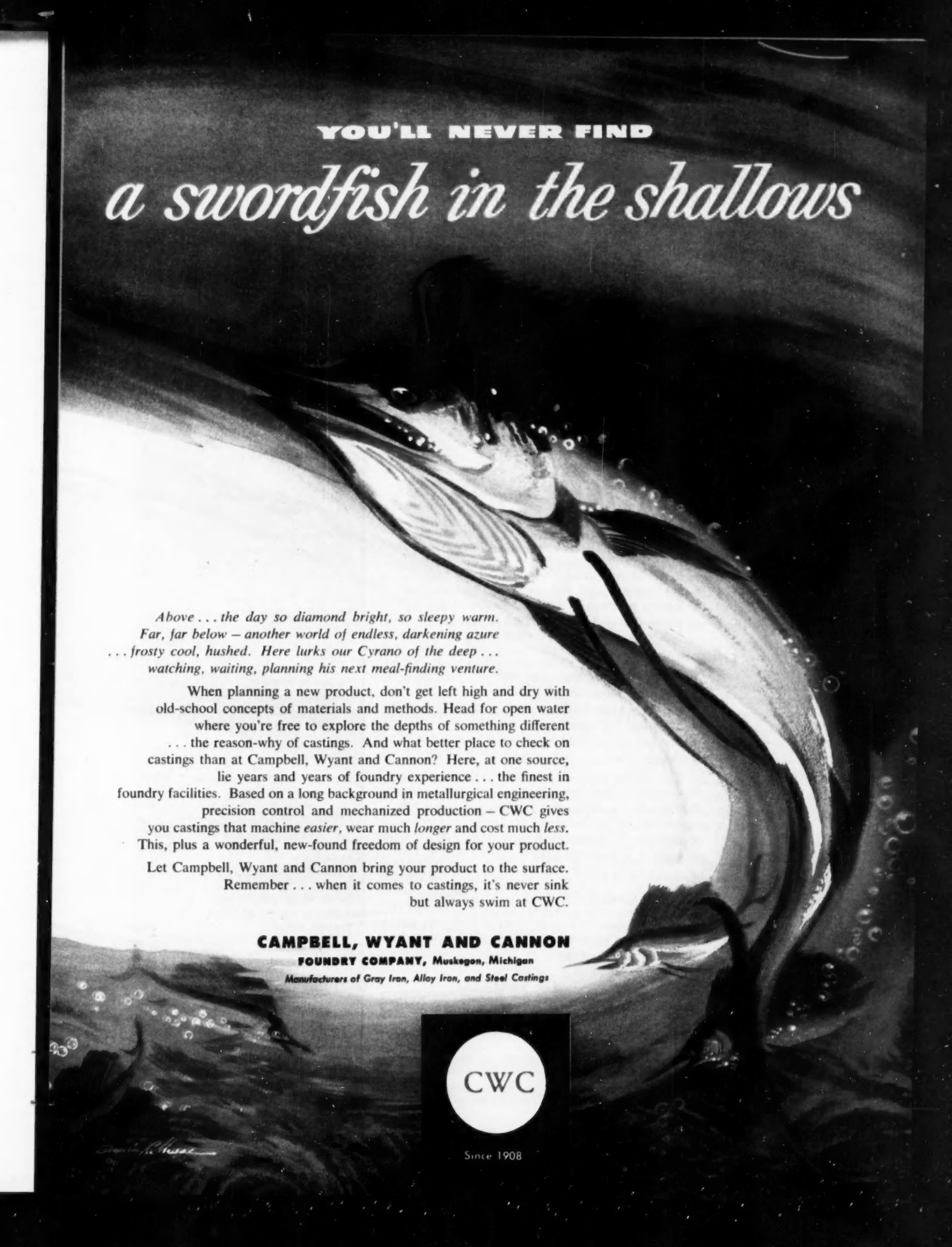
San Diego Section

John G. Brown, Carl Louis Frasher, A. Woodrow Grindle, Edwin Richard Henneberg, George A. Lemke, Herbert P. Rasp, Merrill M. Reeder, Robert Lloyd Trussell.

Southern California Section

Harry P. Beran, Edward Gerton Boden, Ed S. Burdick, Robert John Cooper, Richard J. Corbett, Harry Ewing Cornish, Douglas Frank Corsette, William H. Devenport, John Dunstan, Arthur Eck, Robert E. Field, Harry C. Foster, Stanley Groner, Carl William Hay, Walter E. Hekala, Harry N. Hill, William C. Hurd, Charles George Knapp, Perry L. Kruckenberg, Bavard H. Lalande, Jr., Leonard

Continued on Page 122


YOU'LL NEVER FIND
a swordfish in the shallows
Above . . . the day so diamond bright, so sleepy warm. Far, far below – another world of endless, darkening azure . . . frosty cool, hushed. Here lurks our Cyrano of the deep . . . watching, waiting, planning his next meal-finding venture.
When planning a new product, don't get left high and dry with old-school concepts of materials and methods. Head for open water where you're free to explore the depths of something different . . . the reason-why of castings. And what better place to check on castings than at Campbell, Wyant and Cannon? Here, at one source, lie years and years of foundry experience . . . the finest in foundry facilities. Based on a long background in metallurgical engineering, precision control and mechanized production – CWC gives you castings that machine easier, wear much longer and cost much less. This, plus a wonderful, new-found freedom of design for your product.
Let Campbell, Wyant and Cannon bring your product to the surface. Remember . . . when it comes to castings, it's never sink but always swim at CWC.
CAMPBELL, WYANT AND CANNON
FOUNDRY COMPANY, Muskegon, Michigan
Manufacturers of Gray Iron, Alloy Iron, and Steel Castings
CWC
Since 1908

Applications Received

continued

Lance, Richard D. Livingston, Jr., Walter F. Keller, Leon Louis Lyons, Richard Kenneth Mallis, Eric L. Martin, Manabi Matoba, Raymon M. Miller, Michael Moroso, Robert J. Petersen, John J. Petraits, Charles M. Reid, James F. Renhult, Robert James Ross, Eugene Thomas Sullivan, John Susnir, A. Armond Tolomeo.

Southern New England Section

Carl A. Bailey, Robert Lovejoy Beattie, Donald L. Brown, Jr., Allen Edward Cable, David W. Cogswell, Harold W. Dean, Calvin D. Holbert, Donald Charles Marr, George C. Peterson, Richard W. Rupert.

Spokane-Intermountain Section

W. E. Kellogg.

Texas Section

Charles J. Kam, George Edward Lange, Edward J. Roseler.

Texas Gulf Coast Section

Alexander Cameron English, Jr., A. C. Manis, Joe Manning, Charles F. McGinty, Lt. Willard G. Palm, Bob C. Wright.

Twin City Section

Richard K. Barton, William C. Canby, Frank S. Morgan, David J. Wisehart.

Washington Section

William Robert Harwood, Jr., Carlo J. Roma, Milton M. Slawsky, Donald M. Thompson, Rover Lawrence Tilley.

Western Michigan Section

Albert J. Christopher, Leslie A. Cole, Jr., William C. Martin, Eric C. Nulsen, Allan E. Swartz.

Wichita Section

Vinod K. Rajpaul, Arthur A. Zerry.

Williamsport Group

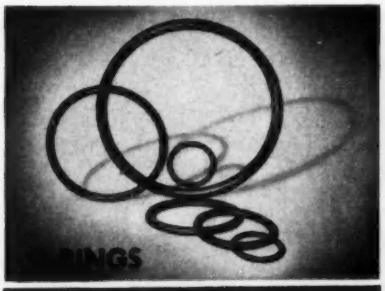
John B. Vassallo.

Outside of Section Territory

Lee G. Cochran, Gerald W. DeLoy, Donald Peter Diemer, Orvis J. Fairbanks, Charles George Fletcher, Robert W. Giertz, Roy Alexander Hinchliffe, John H. Jessen, John Joseph Martin, James H. Muncaster, Joffre Poincare Myers, M. L. Nelson.

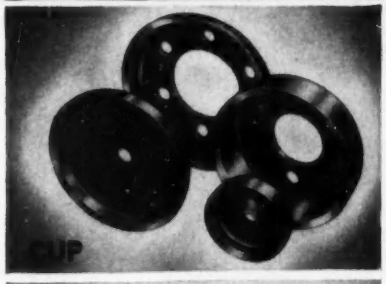
Foreign

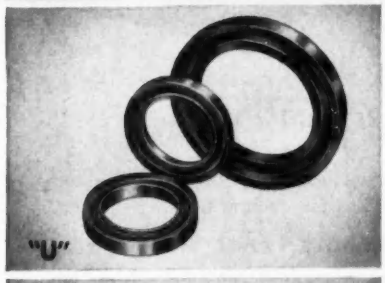
Oliver L. Grimes, Saudi Arabia; Kamalaksh Pai Kasturi, India; Nilal Shashi Prabhakar Naidu, India; C. Parthasarathy, England; J. S. Somayajulu, India; Achille Giovanni Vannucci, Italy.

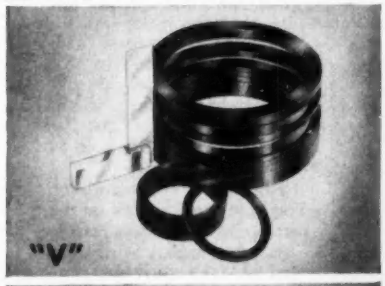


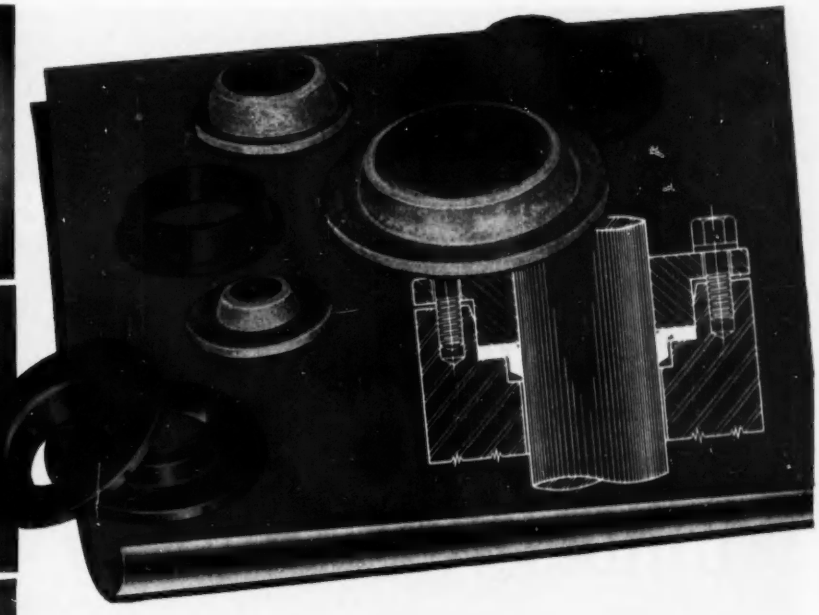
FLANGE PACKINGS

Made of leather or rubber. Installed in recess around a rotating or reciprocating shaft. Sealing lip and inner side wall form dynamic seal on shaft. Gland nose forms compression seal on shaft.









NOW . . . it's easier to order G&K-INTERNATIONAL Packings — always uniformly accurate

The Joint Industry Conference, together with packings manufacturers and government agencies, have set up dimensional standards for each packings type — identified by a Dash Number — making it easier for you to order, assuring greater accuracy and faster service.

You'll find all the code numbers in our new Packings Catalog and Manual — of course, we still require information as to mediums, pressures, temperatures.

But because G&K-International follows the standard specifications — we can save time for you. Our engineers and chemists are also ready to study your non-standard requirements and recommend special types of packings to function in hard-to-do jobs.

Call on G&K-International for *all* your packings needs.

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Consult G&K-International for your replacement needs. You'll find the answer here.

New Packings Catalog

A comprehensive Catalog and Manual covering all up-to-date packings standards you ought to know about for your packings and oil seal needs. We want you to have a copy. Tell us where to send it!

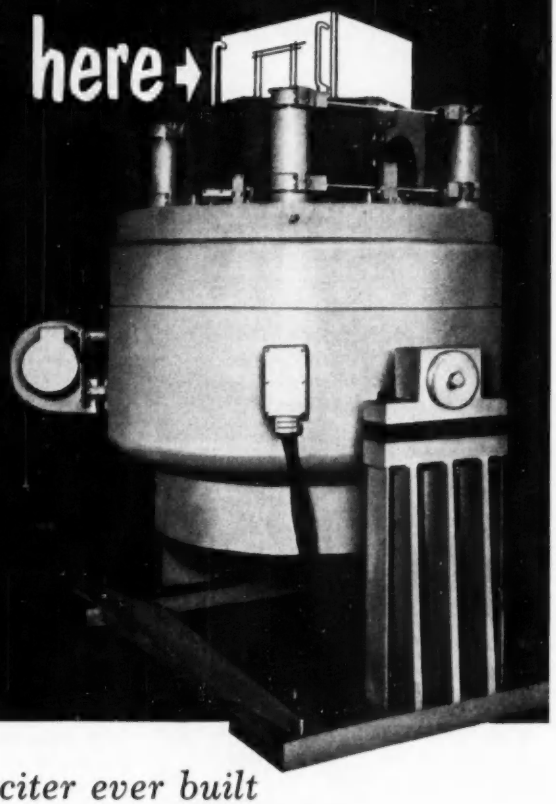
G&K GRATON AND KNIGHT INTERNATIONAL

GRATON & KNIGHT COMPANY
Established 1851
Worcester 4, Massachusetts

INTERNATIONAL PACKINGS CORPORATION
Graton & Knight Company Affiliate
Bristol, New Hampshire

P-6

Put your product here → to shake-test it with 10,000 lbs force



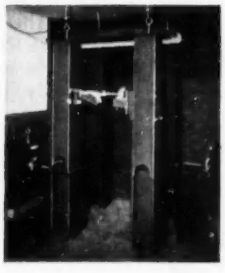
MB produces the largest exciter ever built to meet heavy duty vibration test specifications

THERE'S nothing like a good shaking to test out structural designs, electronic equipment, instruments or complete assemblies for faults or flaws. In fact, for many products put to military use, such tests are *specified*. However, since *all* products encounter some vibration or shock in service, many engineering departments use an MB Exciter to test all designs. By so doing, the "bugs" are discovered in the test laboratory instead of out in the field, at cost of good will.

Largest in the line of MB electromagnetic shakers, the Model C-100 shown delivers at least 5 tons continuous force. Its performance permits heavy duty vibration testing to MIL-E-5272 and other specifications. It incorporates a number of unusual design features for easy, quick, convenient operation—including interlocking controls for complete safety and provisions for cycling tests.

HOW TO HANDLE LARGE MASSES

MB can show you a setup of vibration exciter and resonating beam that multiplies the capacity of versatile MB Exciters many fold. Shaker being used in this fatigue strength test of aircraft engine mounts is the model S-3 rated at 200 lbs. Others available down to 10 lbs. force output.



Vibration is MB's specialty. You're invited to draw on the benefits of this specialization—and get highly qualified products for testing and control, and technical help on your problem.

Valuable bulletins for test engineers Calibrating vibration pickups to 2000 cps is comprehensively covered in MB Bulletin No. C-11-7 Bulletin No. 1-VE-7 describes vibration exciters and details their specifications. Write today.

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1060 State Street, New Haven 11, Conn.

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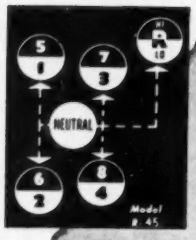
One lever controls

8 FORWARD SPEEDS

TWO REVERSE SPEEDS

NO GEAR-SPLITTING!



New MODEL R-45 ROADRANGER®

Now 125-160 hp rigs can have the advantages of the new R-45 ROADRANGER Transmission

The famous one-stick Fuller ROADRANGER is now available for rigs powered by engines delivering up to 385 pounds-feet of torque.

With the new R-45, gear-splitting is entirely *eliminated*. Shifts are simple, short, and fast, with only one power shift in the whole series. Yet you have 8 forward speeds—available in *equal*, progressive, selective steps, none exceeding 38%—to keep your engine *always* turning in its most efficient range.

With this transmission, there's no more engine lugging, no more low rpm between shifts. With the Fuller ROADRANGER, you can haul more, and maintain higher average speeds than ever before—with so much better utilization of horsepower that you make 1/3 fewer shifts. Write today for full information on the new Fuller R-45 ROADRANGER.

Check These Advantages:

● Easier, quicker shifts—38% steps—one shift lever controls all 8 forward speeds ● No gear-splitting—8 selective gear ratios, evenly and progressively spaced ● Higher average road speeds—engine operates in peak hp range with greater fuel economy ● Less driver fatigue—⅓ less shifting ● Range shifts pre-selected—automatic and synchronized ● More compact than other 8-speed transmissions ● More cargo can be carried on the payload axle.

VITAL STATISTICS

GEAR RATIOS:

Low Range		High Range	
1st	9.78	5th	2.66
2nd	6.98	6th	1.90
3rd	4.99	7th	1.36
4th	3.68	8th	1.00
Reverse	11.01	Reverse	2.99

Installation Length . . . . . 29¾"
Clutch Housing Sizes . . . . . SAE 1, 2, 3
Weight, with Standard Controls . 457 lbs.

Fuller TRANSMISSIONS®

FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • WESTERN DISTRICT OFFICE (SALES & SERVICE—BOTH DIVISIONS), 641 E. 10th Street, Oakland 6, Calif.

Engineered for economy, efficiency and ease of service!

- Bar-type Handle replaces troublesome cover bolts
- Double Center-tube eliminates "Drain Back"
- Neoprene-type Cover Gasket assures positive seal
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The new WIX WF-750 Series Heavy Duty Oil Filters combines superior filtration with maximum service economy. Rugged construction, long service life and simplified cartridge servicing save money, time and labor for truck and heavy-equipment users. Handsome appearance ideal for external mounting. To suit particular service requirements, your vehicle users can choose from three proved WIX Filter Cartridges . . . Can Type, containing a highly absorbent, special blend of paper and wood flock, Sock or Can Types containing WIXITE, the unique, Resilient Density Filtrant. Write for detailed specifications.

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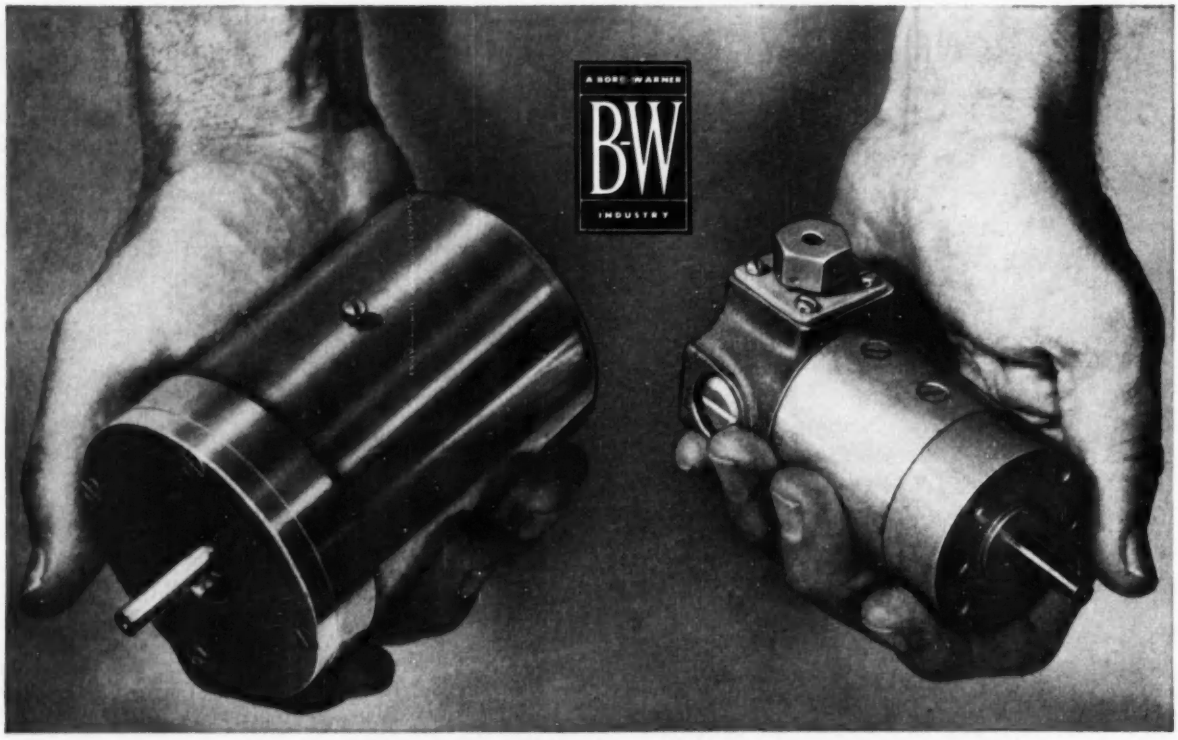
GASTONIA, N. C.

WIX ACCESSORIES CORP., TORONTO, ONT. CANADA



Compact, powerful, custom-built A.C. or D.C. motors for ELECTRONICS and ELECTRO-MECHANICS

Wherever you need electric motors for maximum power in minimum size, Pesco has the basic co-ordinated frame sizes and power elements you'll require.

For example—Pesco motors are now in use for: cooling (blowers for electronic equipment), tuning (radios and automatic finders), scanning antenna (civilian and military), antiaircraft radar fire control, as well as pump drives and mechanical actuators.

By using standardized parts in a series of six co-ordinated frame sizes, Pesco can provide you with electric motors for electronic applications with voltages from 6 to 120 volts D. C.; from 1/100 to 6 H. P. for operating speeds up to 15,000 R. P. M. Special, high-altitude design will operate from −65° to + 165° F.

Pesco high-frequency A.C. induction motors, squirrel-cage type, are built in a series of 5 co-ordinated frame sizes to meet horsepower requirements of .01 to 9.0, at 400 cycles per second.

Motors in these frame sizes can be built for *your* specific frequency, using standard parts to obtain the speed and power rating desired. Consult our Engineering Department concerning your requirements. Strictest confidence—and no obligation, of course!

engineering Pesco production
PRODUCTS DIVISION

BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO

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Automotive manufacturers, knowing and demanding fine quality components, are very likely to consider Clark. Whether the vehicle is a new design or something special, or a redesign of an existing model, you'll find that working with Clark is exceedingly good business.

Turn and see reverse side for more about CLARK products

CLARK EQUIPMENT COMPANY, Buchanan, Michigan

Other Plants: BATTLE CREEK AND JACKSON, MICHIGAN

1903 1953
FIRST FIFTY YEARS
CLARK EQUIPMENT

Tuesday, October 21, 1952 THE MIAMI HERALD 21-A

Financial News

Winn & Lovett's Earnings On Rise

By United Press

JACKSONVILLE—Winn & Lovett Grocery Co. reported for the quarter ended Sept. 20 sharply higher earnings, reflecting economies achieved through mechanization in warehousing and merchandise handling.

Net for the first quarter of the current fiscal year, totaled $600,597, or 44 cents a share on common, compared with $409,342 or 29 cents in the same quarter last year. Net sales of $41,851,672 compared with $36,763,499.

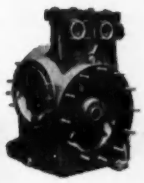
As of Sept. 20, the food chain had in operation 181 retail outlets

How To Make More Money

CLARK EQUIPMENT

gearing for the *Age of Flight* at WESTERN GEAR WORKS

Designing, manufacturing, testing and producing in quantity — one or thousands — of specialized gear drives for the Aviation Industry has been a major activity at Western Gear since the first days of mechanized aircraft. Western Gear aircraft engineers are available to work with you to efficiently and effectively solve your mechanical power transmission problems. Call on us now — no obligation.



5329

Turbine powered auxiliary power unit is shown. Western Gear has designed and built many gear drives for use with gas turbines.

Actuators . . . Illustrated is a special dual powered rotary actuator using both hydraulic and electric motors. Thousands of different types of specialized actuators have come from Western Gear drawing boards.

Avionics . . . Electronics in Aviation . . . electronic equipment manufacturers use Western Gears for many kinds of airborne equipment. Fine pitch differential shown was used on electronic equipment aboard guided missile.

Power-On Scale Models . . . Illustrated is a Western Gear designed and built scale model of counter rotation unit for power-on wind tunnel testing.

Illustrated is a Western Gear main power drive for a wind tunnel. Many standard and special gear drives are available for laboratory, research and other aviation industry experimental projects.

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132-124 W. Colorado St., Pasadena 1, California
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920 S. E. Oak St., Portland 14, Oregon
Room 212, Ross Bldg., Denver 2, Colorado
500 South Ervay Street, Dallas, Texas
Engineering & Machinery Ltd., 1366 W. Broadway, Vancouver, B. C.

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Executive Offices, Post Office Box 182, Lynwood, California

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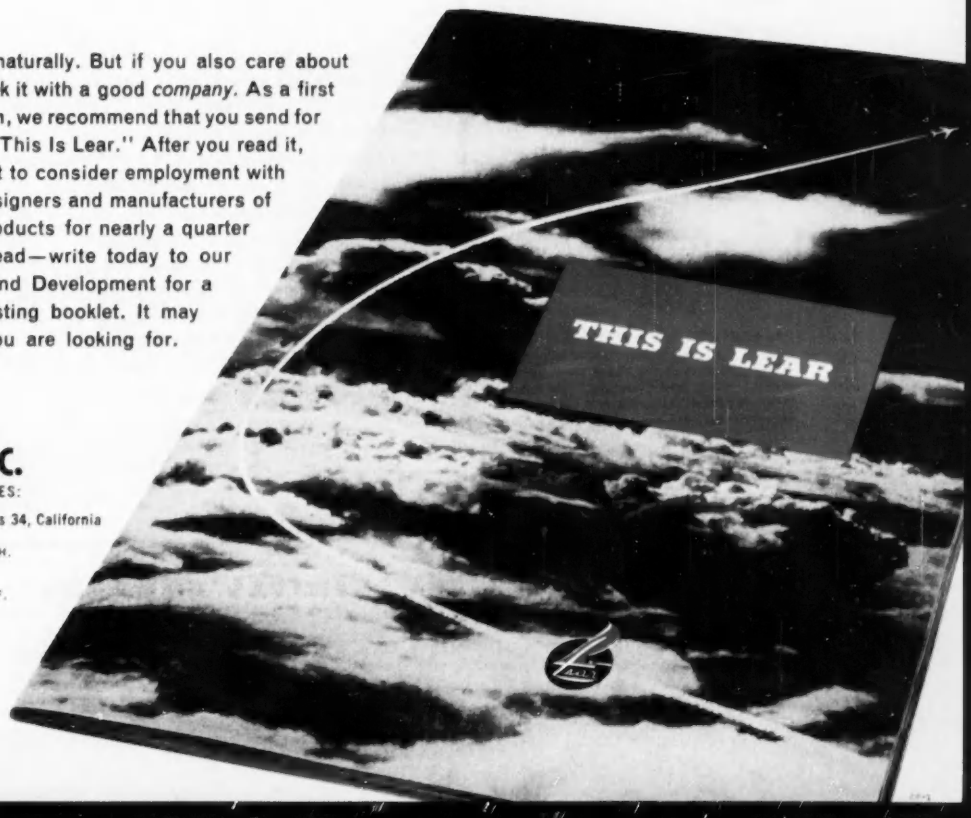

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EXECUTIVE OFFICES:
3171 South Bundy Dr., Los Angeles 34, California

GRAND RAPIDS, MICH.
ELYRIA, OHIO
LOS ANGELES, CALIF.

Presenting

NOW . . . get PERMANENT FIRE RESISTANCE WITH NO LOSS IN HEAT RESISTANCE

TYPICAL PROPERTIES

- **Weight loss of castings:**
  After 168 hrs. at 392°F 2-3%
  After 720 hrs. at 392°F ... 13-15%
- **Flexural strength retention of glass cloth laminates:**
  After 168 hrs. at 392°F .. up to 90%
  After 720 hrs. water immersion 92%
- **Shrinkage during curing.....5%**
- **ASTM heat distortion point of castings ..... 212-220°F**
- **Electrical properties of castings at 10^9 cycles:**
  Dielectric constant 2.85
  Power factor ..... .00575
  Loss factor ..... .0164

FOR COMPLETE INFORMATION on HETRON resins, send today for technical data sheets listing properties of the liquid resins, cured unfilled resins, and glass cloth laminates. Includes general handling and curing recommendations, and other useful information.

In HETRON, a new family of self-extinguishing resins, you will find *in full measure* all the properties a good fire-resistant polyester should have.

Heat resistance, in particular, is outstanding. Castings aged at 200°C lost only 2% of weight in seven days (as compared with 10% or more for standard non-fire-resistant resins, and up to 20% for ordinary fire-resistant resins).

Glass cloth laminates aged at 200°C for seven days retained up to 90% of their room temperature flexural strength. Fire resistance was virtually unchanged in the same period.

HETRON resins are self-extinguishing even without the use of additives, because they contain 30% chemically-bound chlorine. At the same time, they are clear and stable. Where even higher fire resistance is desired, addition of 5% antimony trioxide results in laminates that will not support a flame for one second, even after five repeated applications of a Bunsen flame.

Transmission of water vapor through HETRON resins is very low, compared to standard resins—so low that it is difficult to measure accurately. Absorption of water is also lower. For these reasons, electrical properties of the resins are much less affected by long exposure to high humidities and elevated temperatures than ordinary polyesters.

Shrinkage-on-cure of less than 5% by volume, and little or no air inhibition, are important advantages of the new resins. Resistance to acids is better than that of standard resins. Heat distortion temperatures are better than with many standard polyesters.

HETRON resins are light-colored, transparent viscous liquids. At present, they are available in drum quantities.

The facilities of our laboratories are available to cooperate with you in the application of HETRON polyester resins.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

38-47TH STREET, NIAGARA FALLS, NEW YORK

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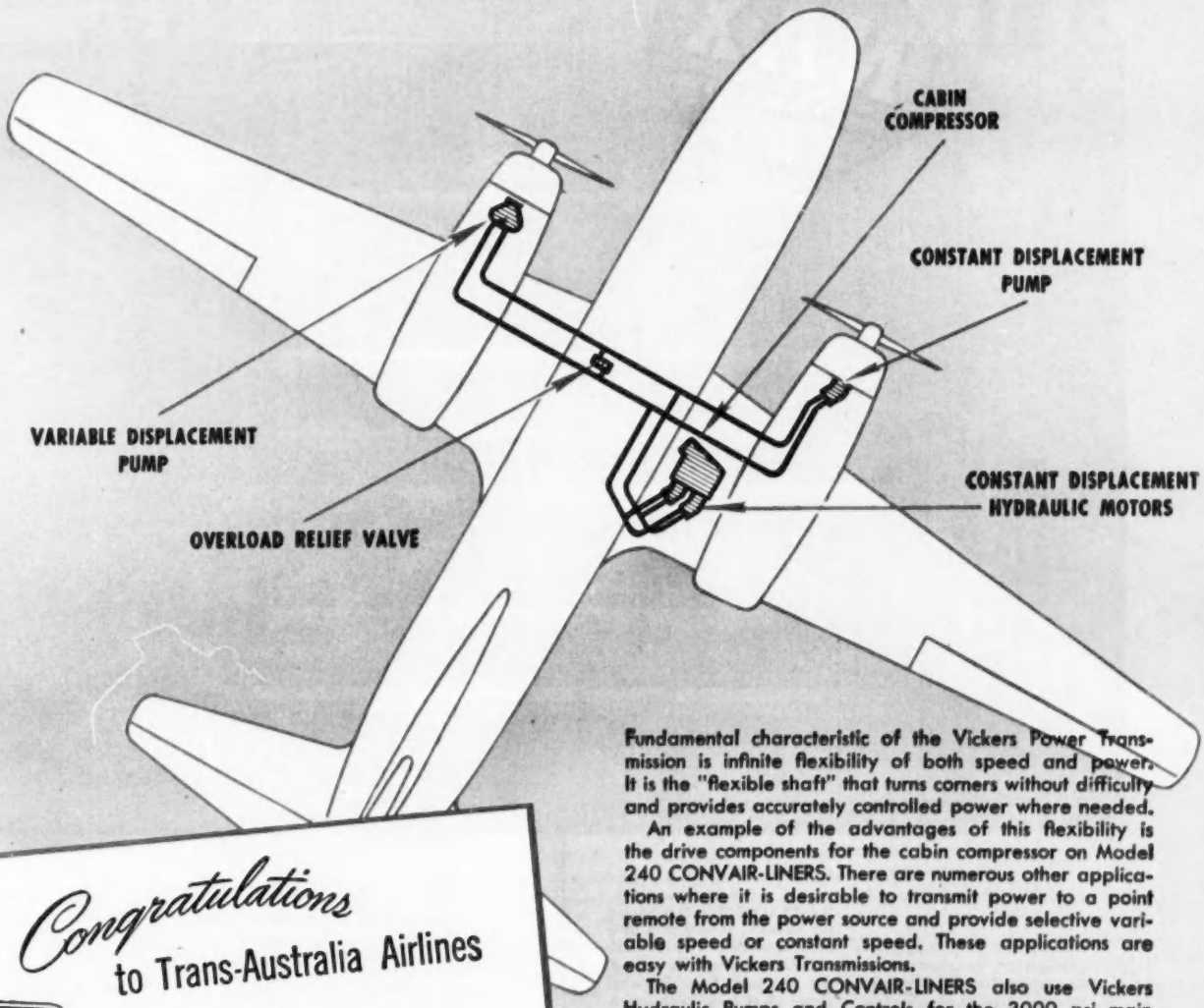
HOOKER CHEMICALS

VICKERS HYDRAULICS

Provides the "variable speed shaft" that

turns corners with ease and delivers power where needed

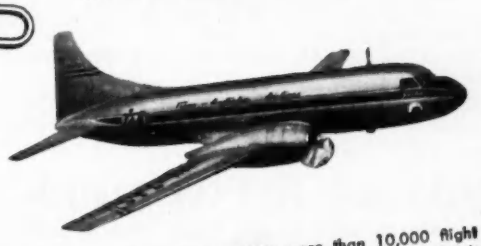


Fundamental characteristic of the Vickers Power Transmission is infinite flexibility of both speed and power. It is the "flexible shaft" that turns corners without difficulty and provides accurately controlled power where needed.

An example of the advantages of this flexibility is the drive components for the cabin compressor on Model 240 CONVAIR-LINERS. There are numerous other applications where it is desirable to transmit power to a point remote from the power source and provide selective variable speed or constant speed. These applications are easy with Vickers Transmissions.

The Model 240 CONVAIR-LINERS also use Vickers Hydraulic Pumps and Controls for the 3000 psi main hydraulic system. In Vickers complete line of aircraft hydraulic equipment, you will find a combination to meet your control or drive needs exactly. Write for your copy of report No. 725, "Hydraulic Drives for Aircraft."

Congratulations
to Trans-Australia Airlines



TAA is the first Airline to accumulate more than 10,000 flight hours on each of their fleet of five CONVAIR 240's. Vickers Inc. is proud to have contributed to this record. In addition to providing the accessories for the main hydraulic system, a Vickers hydraulic drive is used for the cabin compressor. TAA recently reported that flights are flown pressurized more than 97% of the time and that hydraulic problems are insignificant.

6448

VICKERS Incorporated
DIVISION OF THE SPERRY CORPORATION
1440 OAKMAN BLVD. • DETROIT 32, MICHIGAN

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

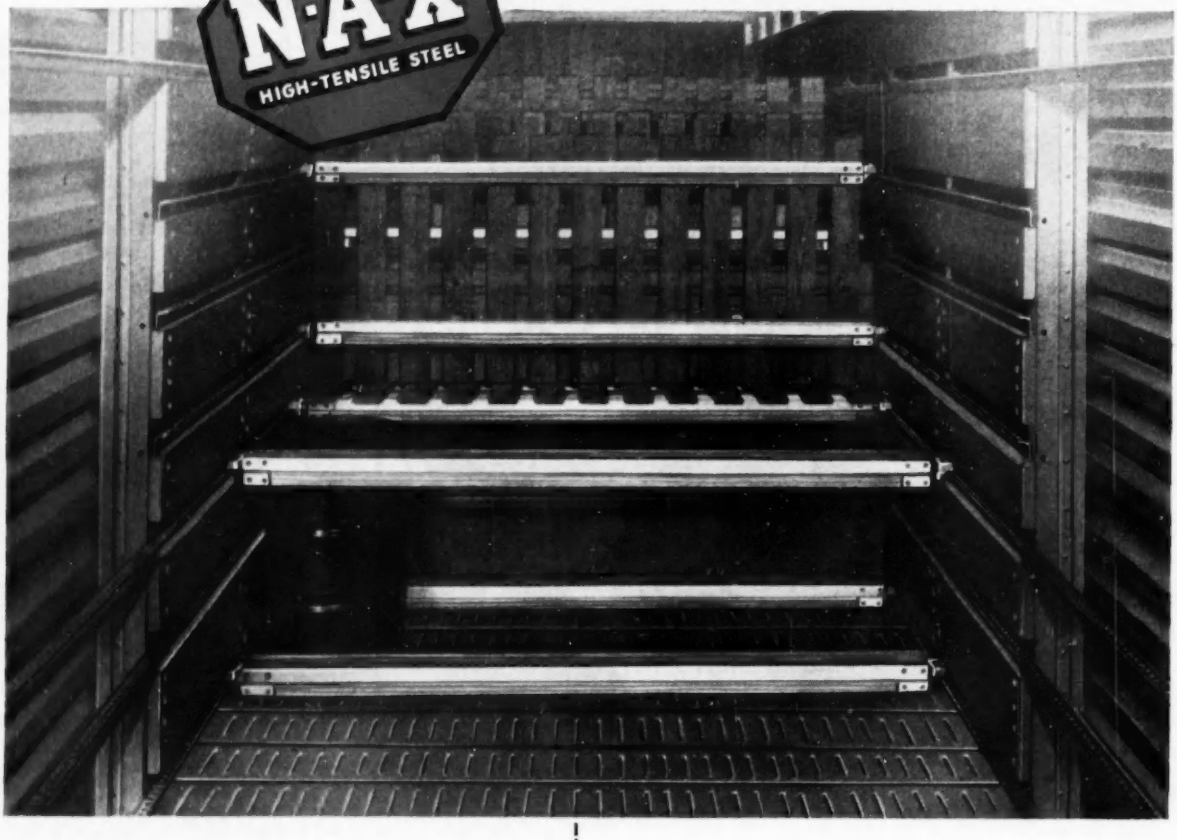
for Greater Strength with Lighter Weight in modern material handling equipment

The increasing use of the Evans DF Loader reflects the progress of railroads toward more efficient material handling methods.

In the DF Loader there is high strength with minimum weight through the use of N-A-X HIGH-TENSILE steel. This low-alloy steel has 50% greater strength than mild carbon steel, with greater resistance to corrosion with either painted or unpainted surfaces.

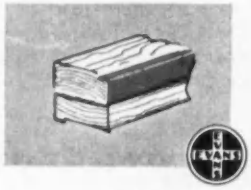
You can get the same results as Evans. Your product can be made stronger, lighter in weight and longer-lasting, when you specify N-A-X HIGH-TENSILE steel.

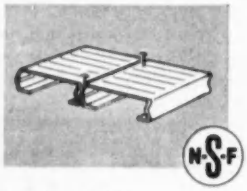
N·A·X HIGH-TENSILE STEEL



THE EVANS DF LOADER is a product of Evans Products Co., Plymouth, Mich. DF means Damage - Free, Dunnage - Free.

NAILABLE STEEL FLOORING for boxcars, flatcars and gondolas is made of N-A-X HIGH-TENSILE steel, and is a product of Steel Floor Division, Great Lakes Steel Corporation.





Engineering data on these products available upon request to the manufacturers.

The "Wonder Bar," a section of which is shown at left, is a vital part of the Evans DF Loader. It is a wooden bar reinforced by a Z-bar made of N-A-X HIGH-TENSILE.

The "Wonder Bar," when locked into place, secures all kinds of lading. It is strong enough to resist shifting load stresses in moving boxcars, yet so light that one man can lift it into position. The DF Loader provides real operating economies for both railroads and shippers.

Another modern product for efficient transportation equipment is Nailable Steel Flooring, also made of N-A-X HIGH-TENSILE steel.

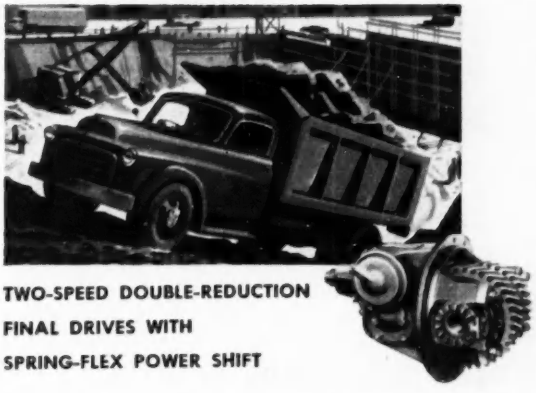
GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Mich.

NATIONAL STEEL CORPORATION

Specify Timken-Detroit two-speed axles with HYPOID GEARING

to combine versatile performance with long-lasting dependability!



TWO-SPEED DOUBLE-REDUCTION FINAL DRIVES WITH SPRING-FLEX POWER SHIFT

These dependable final drives provide an instant choice of gear ratios to meet any speed, load or road conditions. Hypoid gearing is used for the first reduction and helical-spur gearing for the second.

If your operations call for the versatility of two-speed axles, you want to make sure your trucks are equipped with Timken-Detroit two-speed double-reduction axles. Here's why! Timken-Detroit has combined all the benefits of a two-speed axle with the many practical advantages of Hypoid and helical gearing. Available on the complete line—single-speed single-reduction axles, single-speed double-reduction axles, two-speed double-reduction axles and tandem-drive rear axle units — Hypoid gearing has been proved by billions of ton-miles of actual operation. It has plenty of strength to stand up under the most rugged operating conditions. In fact, once you've experienced the low-cost operation, better performance and all-around dependability of Hypoid gearing, you'll specify it on every new truck you buy.

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Plants at: Detroit, Mich. • Oshkosh, Wis. • Utica, N. Y. • Ashtabula, Kenton and Newark, Ohio • New Castle, Pa.

TIMKEN Detroit AXLES

TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted D A Standard

TRADE MARK REGISTERED

Presenting some outstanding "portraits" from

THE **LYCOMING** GALLERY OF FAMOUS AMERICAN PRODUCTS

. . . featuring Lycoming's contributions to these products as seen through the eyes of Boris Artzybasheff, one of America's great contemporary illustrators.

Boris Artzybasheff

Look closely—one of these representative achievements for America's industrial and military leaders may indicate how Lycoming can solve *your* metal-working problem.

See how these "portraits"—with their brief descriptive captions—help interpret Lycoming's wealth of abilities. See why you can depend on Lycoming's versatility of skills, extensive facilities, and well-rounded experience to meet your most exacting metal-working requirements.

Whatever your problem—whether you need creative engineering for "just an idea" in the rough or blueprint stage, or precision or volume production of a finished product—"Look to Lycoming!"

For a more complete story on Lycoming's varied abilities and facilities, write—on your company letterhead—for the interesting, illustrated booklet "Let's Look at Lycoming."

How a helicopter hangs by its "elbows"

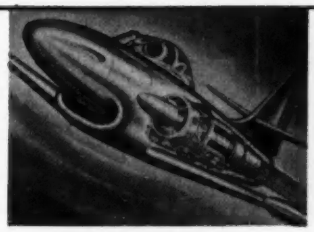
For flexible "elbows"—rotor assemblies that control the amazing maneuvers of its H-21 "Work-Horse" Helicopter—PIASECKI *looks to Lycoming* for precision production.

FOR RESEARCH • FOR PRECISION PRODUCTION

LOOK TO **LYCOMING**

Lycoming-Spencer Division, Williamsport, Pa. AVCO Bridgeport-Lycoming Division, Stratford, Conn.

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION



"Blasts" for jets

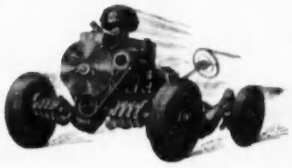
To precision-produce tough, unfailing major components that put the "blast" in its superb J-47 jet engine . . . GENERAL ELECTRIC *looks to Lycoming.*

New "ticker" for tanks

For a dependable tank "heart"—500 horsepower's worth of rugged, air-cooled engine—U. S. ARMY ORDNANCE *looks to Lycoming*, pioneer in the air-cooled engine field.

"Air horses" for lifesaving over the sea

To help swell the volume production of the mighty Wright-Cyclone engine —dependable "horses" for hazardous air-sea rescue work—CURTISS-WRIGHT *and the* U. S. AIR FORCE *look to Lycoming.*



"Sinews" to give cars "go"

For vital automotive parts—precision-machined components that can "take it," year in and year out, leading *automobile manufacturers, like* FORD, *have long looked to Lycoming.*

How a jet engine runs on its "nerves"

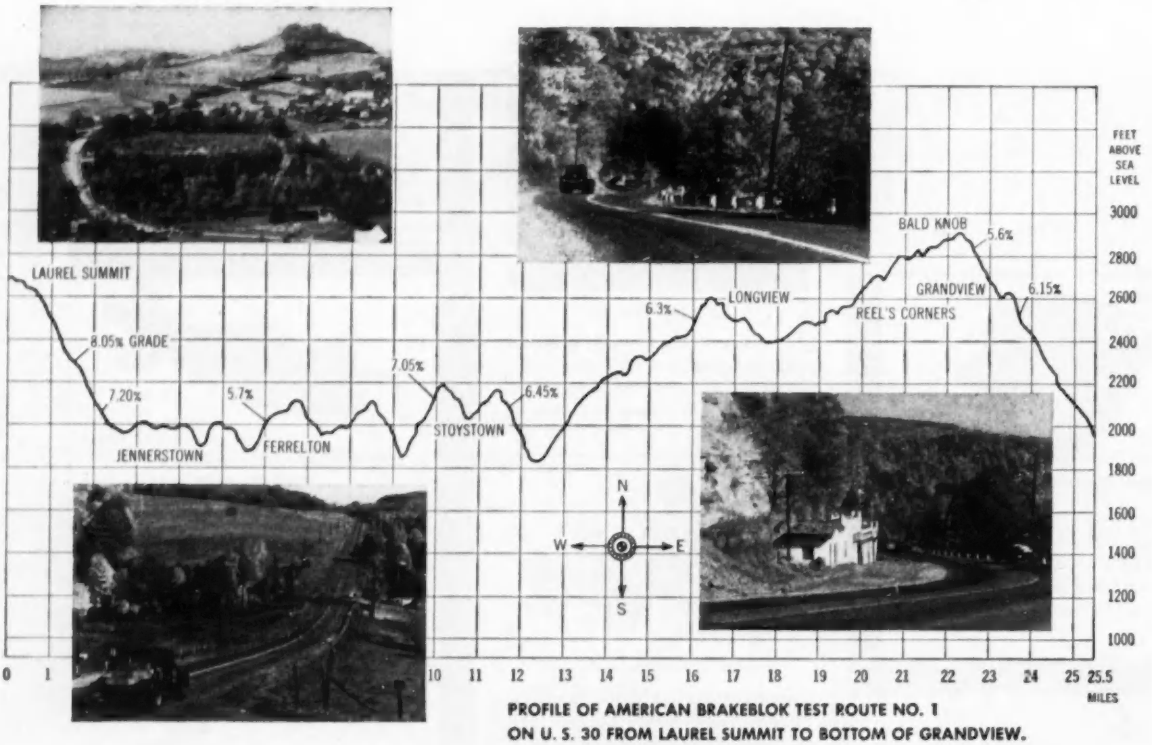
To produce the auxiliary "nerve center" for its J-40 jet engine—a complex gearbox that transmits power to vital accessories—WESTINGHOUSE *looks to Lycoming.*

Presenting some of America's leaders who

LOOK TO LYCOMING

AERO DESIGN AND ENGINEERING COMPANY
AMERICAN CAR AND FOUNDRY COMPANY
AIR MATERIEL COMMAND
BEECH AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
CESSNA AIRCRAFT CORPORATION
THE CLEVELAND PNEUMATIC TOOL COMPANY
DOMAN HELICOPTERS, INC.
FOOD MACHINERY & CHEMICAL CORPORATION
FORD MOTOR COMPANY
GENERAL ELECTRIC COMPANY
GENERAL MOTORS CORPORATION—
CHEVROLET-AVIATION ENGINE DIVISION
DETROIT TRANSMISSION DIVISION
INTERNATIONAL BUSINESS MACHINES CORPORATION
KAMAN HELICOPTER CORPORATION
NAVY BUREAU OF AERONAUTICS
NEW IDEA FARM EQUIPMENT COMPANY
PIASECKI HELICOPTER CORPORATION
PIPER AIRCRAFT CORPORATION
PRATT & WHITNEY AIRCRAFT
RYAN AERONAUTICAL CORPORATION
SYLVANIA ELECTRIC PRODUCTS, INC.
THOMPSON PRODUCTS, INCORPORATED
U. S. ARMY ORDNANCE
WESTINGHOUSE ELECTRIC CORPORATION
WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT CORPORATION

TORTURE TRACK *25.5 MILES LONG!*



PROFILE OF AMERICAN BRAKEBLOK TEST ROUTE NO. 1
ON U. S. 30 FROM LAUREL SUMMIT TO BOTTOM OF GRANDVIEW.

. . . to develop the best brake lining for you

American Brakeblok Test Trucks follow this course daily. Under all conditions of load the lining is put through every possible test—performance, fade, recovery, moisture sensitivity, wear, glaze, and maximum heat resistance. Accurate instrumentation records test data for interpretation by our research staff.

The mountains of Pennsylvania were selected because of their sharp grades, long descents, hairpin curves and dangerous intersections, giving the best opportunity for testing brake lining through a wide range of operating conditions.

On this track . . . today's brake linings are perfected—tomorrow's proven . . . for maximum safety, performance and life.

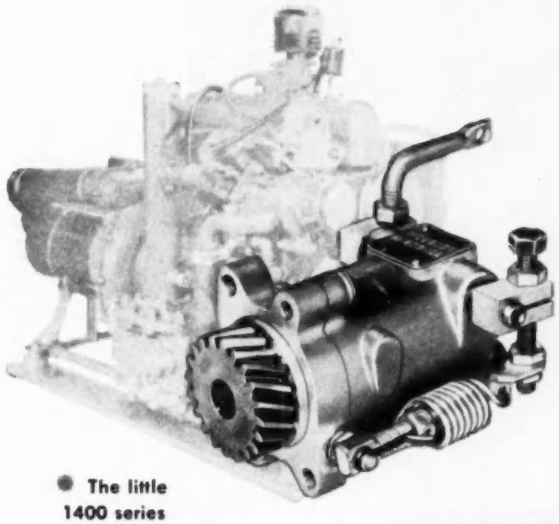
American Brakeblok

THE SAFETY BRAKE LINING

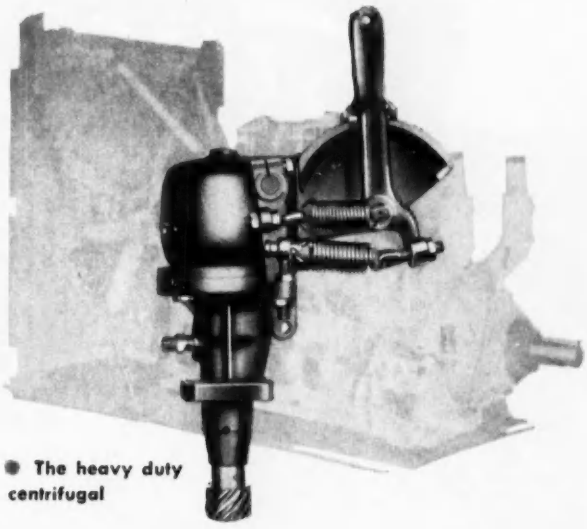
AMERICAN Brake Shoe COMPANY

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN

Plants in: Detroit, Michigan; Winchester, Virginia; Lindsay, Ontario; Gif, France



● The little 1400 series

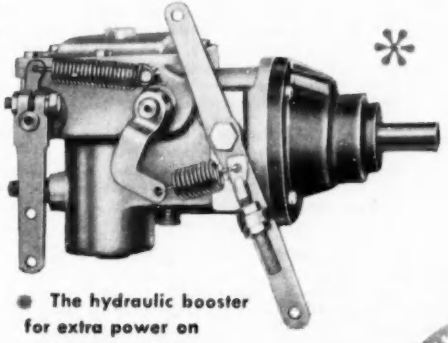


● The heavy duty centrifugal

PIERCE GOVERNORS

preferred for gas (LPG), gasoline and diesel industrial engines... big, medium and small

● The standard long range 900 series



● The hydraulic booster for extra power on racks and valves

Pierce centrifugal governors are your most dependable and efficient control mechanisms for industrial engines . . . from small generator sets to monster power units . . . gas (LPG), gasoline or diesel. For engines requiring extra power to position fuel rack or valve, the Pierce centrifugal with hydraulic booster* (for original equipment only) is ideal! Pierce offers a ready solution to most engine governing problems . . . send full details and specifications on your particular problem. Complete engineering service available.

PIERCE — THE MARK OF QUALITY

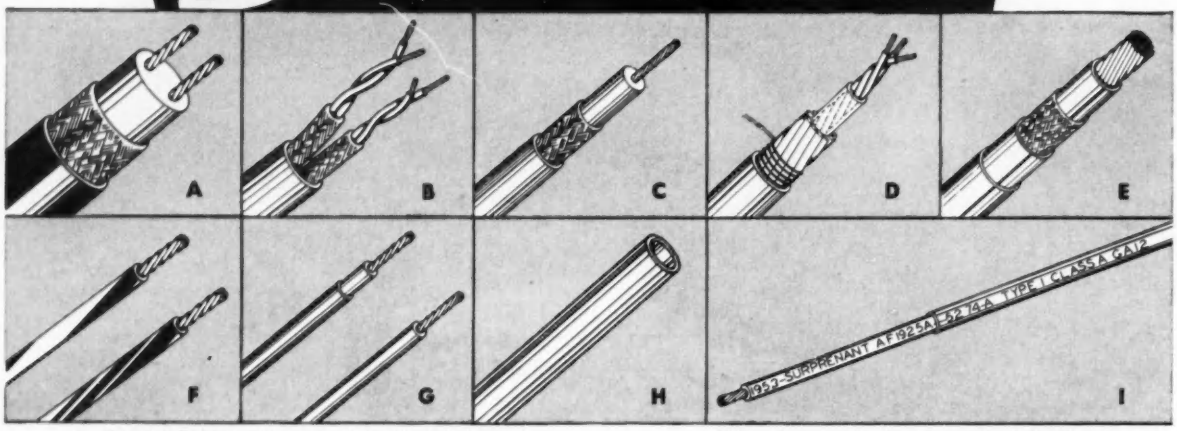
THE PIERCE GOVERNOR CO., INC.

1602 OHIO AVENUE, ANDERSON, INDIANA

"World's Most Experienced Governor Manufacturer"

Surco WIRE · CABLES · TUBING

OPERATING TEMPERATURES FROM -60°C TO 210° C SIZES FROM 32 TO 4/0



A **Coaxial Cables**—"Surco" coaxial cables include a wide variety of types, such as low capacity, extra flexibility, small diameter, microphone 2 conductor, and high temperature "Teflon". Conform to Military Spec. Jan-C-17A. Many special designs. If you have a coaxial cable problem consult us.

B **Miniature Wire & Cable**—"Surco" miniature wire and cables are made in conductor sizes down to No. 32 AWG in stranded and solid. Close control in manufacturing permits small finished diameters on both single and multi-conductor cable. Available in standard colors with and without nylon jacket or shielding in the various vinyl or polyethylene compounds.

C **"Surflene" Insulated Hook-up Wire**—"Surflene", extruded monochlorotrifluoro-ethylene, has excellent resistance to heat, abrasion, and most chemicals, including nitric acid. Having high dielectric strength and insulation resistance, it is especially useful in totally enclosed applications with continuous temperatures up to 135°C. "Surflene" is available in 15 solid colors and wall thicknesses down to 0.008". "Spiralon" colors presently under development.

D **Multi-Conductor Cables**—"Surprenant" multi-conductor cables are available with conductor sizes from No. 32 AWG and larger, with or without nylon jacket or shielding and can be made to specification for special design and applications. Close tolerances permit unusually small overall diameters and "Spiralon" color coding permits easy identification even when hundreds of conductors are involved.

E **New Improved Aircraft Wire**—Surprenant new lightweight, smaller diameter MD wire-(vinyl-glass braid-nylon) and the standard Surprenant sandwich construction (vinyl-glass braid-vinyl-nylon) give excellent overload safety, high and low temperature performance, good electrical properties and have a nylon jacket giving greater resistance to abrasion, fungus, moisture, hydraulic and other oils (nylon braided jacket on sizes 10 AWG and larger for greater flexibility) and are made to conform to MIL-W-5086. "Surprenant" also offers nylon jacketed–polyvinyl-chloride construction made to conform to Military Spec. AN-J-C-48A.

F **"Spiralon"**—"Surco-Spiralon" color coding is available on all vinyl, polyethylene, and nylon insulated wires, with or without nylon jackets. One, two, or three color stripes are available in the standard Nema colors providing almost unlimited color identifications.

Solid color insulation is also available in the 10 standard Nema colors.

G **"Surco" A-10 For (105°C) Hook-up Wire**—A-10 is an unusually high grade vinyl insulating compound developed in our own laboratories for a better hook-up wire. It has excellent resistance to deformation, soldering, high temperature, low temperature and aging; high electrical properties; Underwriters Lab. approved for continuous operation to 105°C without fibrous covering. A-10 insulated wire made to conform to MIL-W-16878.

JAN-C-76 Hook-up Wire—Made to conform to Military Spec. (WL-SRIR-SRHV-SRRF) in all sizes. WL available with nylon jacket or glass braid. The nylon jacket has greater abrasion resistance and high surface resistivity under adverse conditions. SRIR-SRHV-SRRF available with primary insulation only or with the addition of a glass braided covering. All standard colors including "Spiralon" spiral striping.

H **"Surco" Tubing**—"Surco" vinyl tubing is available in special formulations to provide low temperature (−65°C), high temperature (U.L. approved for 105°C), high dielectric strength, flexibility and colors. Standard compounds are carried in stock in regular sizes. Polyethylene and nylon tubing are also available and are carried in stock in natural color, limited sizes.

I **MIL-W-5274A Radar & Electronic Hook-up Wire**—Made to conform to Air Forces Spec., this wire offers excellent low temperature performance. Nylon jacketed, it has high abrasion resistance and superior surface resistivity even under adverse humidity conditions, making it very adaptable for high impedance circuits.

Extruded THIN-WALL Teflon INSULATED (210°C) HOOK-UP WIRE

Extruded Thin-Wall Teflon Insulated (210°C) Hook-Up Wire—Continuously operable over the range from −90°C to 210°C without appreciable deterioration, extruded "Teflon" (polytetrafluoroethylene) is now available in walls as thin as 0.010" (type WTE) and 0.015" (type RTE). Teflon combines non-flammability, chemical and solvent resistance, high volume and surface resistivity with extremely low electrical losses. This wire is available in all flexible strandings from AWG 30 to AWG 10 and conforms to performance requirements of MIL-W-16878. Colors conform to MIL-STD-104.

Surprenant MFG. CO.

"Engineered Wire and Cable for the Electronic and Aircraft Industries"

199 WASHINGTON ST. BOSTON 8, MASS. Plant CLINTON, MASS.

A RISE-AND-FALL THAT ALSO TURNS

...may hold an idea YOU can use!

In many engines, the Thompson-developed "Rotocap" systematically rotates the engine exhaust valves as they rise and fall. This rotation greatly extends valve life.

This same principle... using *linear* motion to produce *rotary* motion... may have undreamed-of applications in *your* product. The Valve Division can work with you to engineer adaptations of these Thompson "Rotocaps" in dime-size units for delicate machines or as rugged giants for heavy machinery.

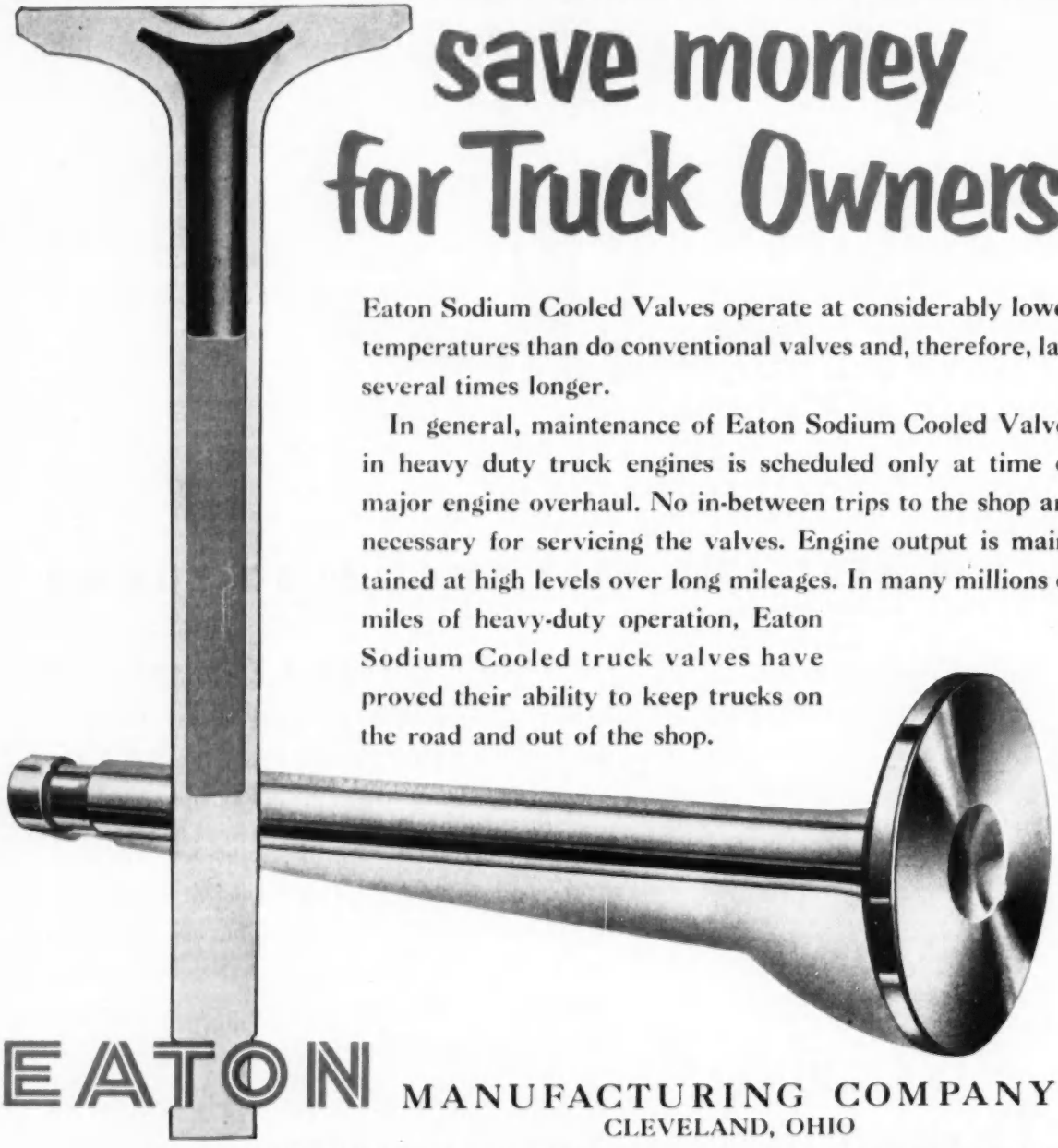
We'd like to explore with you new fields and uses for the "Rotocap"... a simple device for making back-and-forth strokes turn in measured steps.

VALVE DIVISION

Thompson Products, Inc.

DEPT. VS-11 • CLEVELAND 17, OHIO

Eaton SODIUM COOLED VALVES save money for Truck Owners



Eaton Sodium Cooled Valves operate at considerably lower temperatures than do conventional valves and, therefore, last several times longer.

In general, maintenance of Eaton Sodium Cooled Valves in heavy duty truck engines is scheduled only at time of major engine overhaul. No in-between trips to the shop are necessary for servicing the valves. Engine output is maintained at high levels over long mileages. In many millions of miles of heavy-duty operation, Eaton Sodium Cooled truck valves have proved their ability to keep trucks on the road and out of the shop.

EATON MANUFACTURING COMPANY
CLEVELAND, OHIO

VALVE DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

McQUAY-NORRIS

PISTON RINGS

Manufacturers have recognized the
engineering and production skills
of McQuay-Norris in the piston ring
field for more than 40 years.
For Piston rings to meet every requirement
— no matter how exacting —
our engineering know-how is at your disposal.

McQUAY-NORRIS
LEAK-PROOF
PISTON
RINGS
FOR YOUR CAR

McQUAY-NORRIS MFG. CO. • ST. LOUIS 10, MO.

nothing can match the genuine . . .

FURS BY FREDRICA

Designing, Developing, Engineering, Manufacturing and Service

Spicer

Man aspires . . . nature transpires. The standards of excellence achieved in nature's masterpieces cannot be duplicated by the hand of man. Yet man . . . each in his own field . . . achieves his own incomparable measure of success. Through pioneering, research and progress in the field of automotive power transmission, Spicer has during the past 50 years established an enviable reputation as the

Leader in the Industry.

nothing can match the genuine . . .

The great preference for Spicer Universal Joints and Propeller Shafts is the result of many exclusive advantages, both in manufacturing experience and design.

Spicer revolutionized automotive power transmission in 1904 with the invention of the first practical universal joint.

Spicer developed the telescoping action so necessary in propeller shaft action.

Spicer developed the flange yoke and companion flange idea.

Spicer developed the outer casing of universal joints for better lubrication and protection.

Spicer introduced spring retainers that automatically compensate for packing wear.

Spicer pioneered the tubular shaft which enabled large diameters to be used with light weight.

Spicer developed the I-G type joint to seal in lubricant.

Spicer perfected cageless roller bearings, giving the Spicer Universal Joint far greater load capacity at higher speeds with less friction than any other type of similar product.

Nothing can match the genuine!

SPICER MANUFACTURING DIVISION
of Dana Corporation · Toledo 1, Ohio

49 YEARS OF Spicer SERVICE

ENGINEERING DANA MANUFACTURING

TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • WELDED TUBING

ONE OF A SERIES

On Our Golden Anniversary we salute the . . . . .

Industrial Engine Manufacturers

Stretching over the United States, miles from the nearest power lines, are mines, oil fields, road construction crews, and many others whose entire operations are made possible only through power supplied by industrial engines.

At one time, these "outpost" businesses had to depend upon power from water or wind, or run in from lines over miles of difficult terrain. The expense and uncertainty of these power sources made many operations commercially unfeasible, but today with rugged dependable industrial engines at work, inexpensive power is at man's disposal in even the most remote and inaccessible places.

In these and in many other applications, industrial engines are making a real contribution to today's living, and Burgess-Norton, producing piston pins and other precision parts, is gratified for its role in adding to the dependable performance of these engines.

BURGESS-NORTON MFG. CO.

GENEVA, ILLINOIS

SERVING INDUSTRY FOR 50 YEARS

STROMBERG

CARBURETORS

Judge

Carburetor Value as though you were Buying rather than Building the Car!

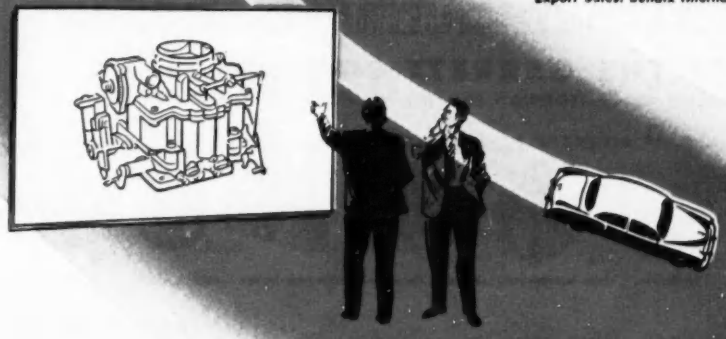
Put yourself in your customer's shoes. *Lasting performance* is vital to him—and it's certain to effect the selection of his *next* car. It is only logical then, to specify components that will insure that characteristic in the engines you build. In carburetors, Stromberg is unique in this respect, for it is a proven fact that Stromberg* Carburetors *last longer*. Take the *long-range* view of carburetor value and you will agree, it's good business to specify Stromberg Carburetors.

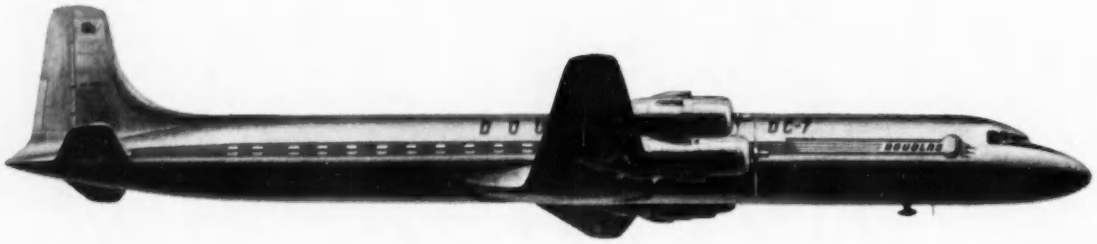
*REG. U. S. PAT. OFF.

ECLIPSE MACHINE DIVISION OF Bendix AVIATION CORPORATION

• Standard Equipment Sales: Elmira, N. Y.
• Service Sales: South Bend, Ind.

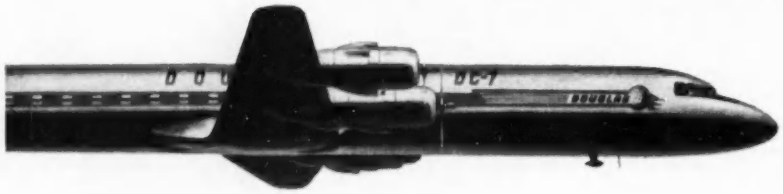
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.



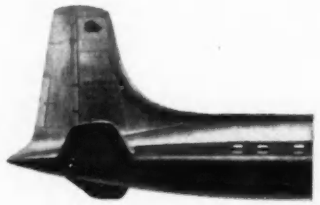


76 AiRESEARCH UNITS

ON EACH GREAT



NEW DOUGLAS DC-7



Another step forward has been taken in commercial aviation with the advent of the 400 mph DC-7. And as always when new sky frontiers are crossed, AiResearch products are doing a big job as part of the team!

Would you like to work with us?
Qualified engineers, scientists and skilled craftsmen are needed here.

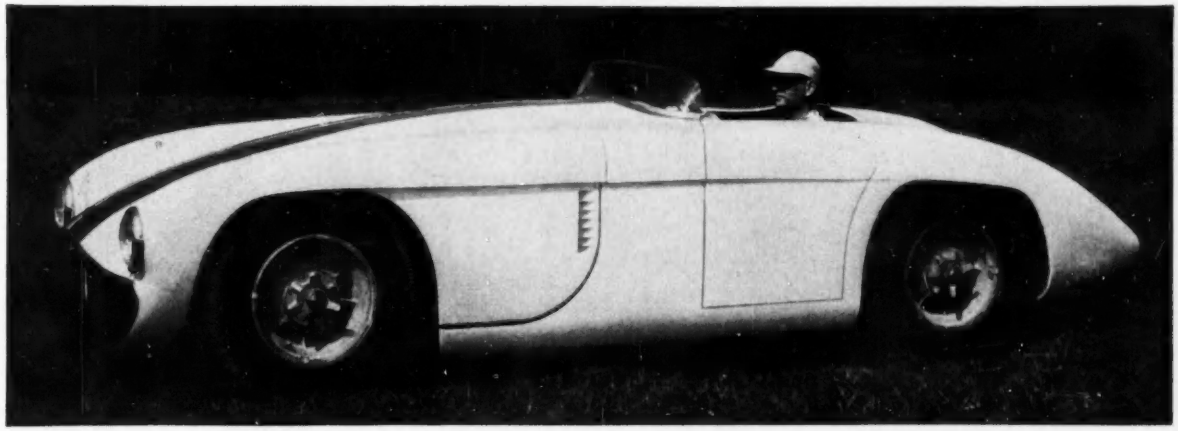
AiResearch Manufacturing Company

A DIVISION OF THE GARRETT CORPORATION

LOS ANGELES 45, CALIFORNIA • PHOENIX, ARIZONA

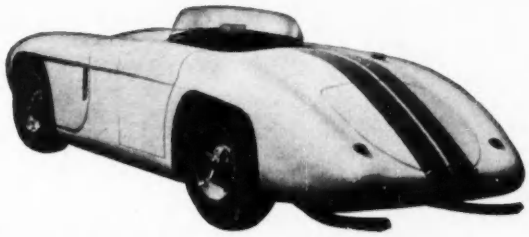
DESIGNER AND MANUFACTURER OF AIRCRAFT EQUIPMENT IN THESE MAJOR CATEGORIES

Air Turbine Refrigeration · Heat Transfer Equipment · Electric Actuators · Gas Turbines · Cabin Superchargers · Pneumatic Power Units · Electronic Controls · Cabin Pressure Controls · Temperature Controls



THOMPSON ENGINEERS PISTONS FOR:

AIRPLANES
CARS
TRUCKS
BUSES
TRACTORS
***...and* RACING CARS**



One of the three Cunningham racers, all of which finished in the first ten places in the recent Le Mans 24 hour race. Nicknamed "Le Requin Souriant" (the smiling shark) by the French, the famed speed cars were equipped with special Thompson built pistons.

Speaking of the pistons which were precision-engineered by Thompson's Light Metals Division, Phil Walters, driver of the C-5R which set a new record of 152.5 mph for one kilometer during the Le Mans race, says, "the pistons worked perfectly.

THE special pistons precision-engineered for the famed Cunningham racers serve as an added indication of Thompson's Light Metals Division versatility.

The same manufacturing techniques and skills are used in producing precision-engineered pistons which work perfectly in gasoline and diesel engines for passenger cars, trucks, tractors and buses.

And, Thompson's Light Metals facilities are not limited to piston manufacture—light, strong, durable metal castings are constantly being engineered, designed and produced for a wide range of customer uses.

A background of over 50 years in research and manufacture of precision metal parts enables Thompson to offer aid to all forms of industry. Today it is producing light metal castings for such diversified products as aircraft and washing machines; buses and garbage disposers; tractors and outboard motors; automobiles and industrial engines.

Regardless of your product, if you use castings, Thompson's creative engineers will gladly show you when and how you can simplify your operations and save on costs with Thompson's Light Metal castings.

For a detailed description of the Thompson Light Metals Division operations, send for your free copy of "Creative Castings". Just write, on your company stationery, to Dept. J-3, Light Metals Division, Thompson Products, Inc., 2269 Ashland Road, Cleveland 3, O.

You can count on

Thompson Products

LIGHT METALS DIVISION
2269 Ashland Road • Cleveland 3, Ohio

...*when you LEAD them*, that's game in the BAG

You have to shoot *ahead* of fast-moving game, if you want to take home something for dinner. Same with business. Now's the time to plan for the day when you can get all the materials you want, with allocations gone, orders maybe not so plentiful, and competition red-hot. ● Allegheny Stainless Steel can work marvels in adding sales advantages to the products you make, or reducing operating costs in the equipment you use. Let our Development Engineers show you how.

Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.

AL
TIME-TESTED
STAINLESS STEEL

Warehouse stocks carried by all Ryerson plants

You can make it *BETTER* with

Allegheny Metal

KELSEY-HAYES

Power Braking

DRIVE THE SAFEST, EASIEST WAY WITHOUT LIFTING EITHER FOOT

- Just as your *RIGHT* foot on the Accelerator Pedal is always ready for *"GO-POWER"* . . .
- *SO* . . . your *LEFT* foot on a similar low pedal is always ready for *"STOP-POWER"* . . . with *KELSEY-HAYES POWER BRAKING!*
- Thus, you always drive comfortably relaxed, yet with *BOTH FEET* constantly in position to act the *FASTEST IN ANY EMERGENCY.*
- Here, definitely is the last word in *SAFEST AND EASIEST POWER BRAKING* for the modern car.

Wheels, Brakes, Hubs and Drums . . . also Parts for Farm Implements and Aircraft

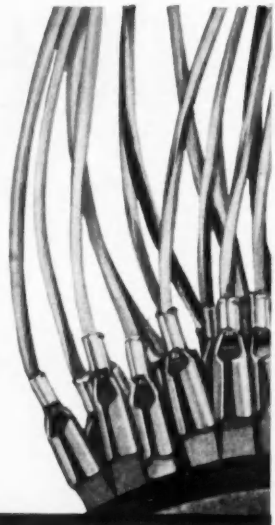
KELSEY-HAYES WHEEL COMPANY

DETROIT 32, MICHIGAN

PLANTS IN DETROIT AND JACKSON, MICHIGAN; McKEESPORT, PA.;
LOS ANGELES, CALIF.; DAVENPORT, IOWA; WINDSOR, ONTARIO, CANADA

KH

A NEW TERMINATION TECHNIQUE FOR . . .



- COMPUTERS
- SWITCHBOARDS AND INSIDE PLANT EQUIPMENT
- RELAYS, SWITCHES, AND MULTI-CIRCUIT COMPONENTS

AMP FLAT* TAPER

If you are concerned with the wiring of close spaced equipment, investigate the new AMP Solderless TAPER TAB RECEPTACLE for flat relay or switch tabs shown at right. It is self locking when installed on a male tab with matching 3½° taper, yet can be removed and reconnected any number of times without solder or special tools. These terminals are supplied on reels in continuous strip. Customer crimps them on wires using AMP automatic machines at speeds up to 4,000 per hour!

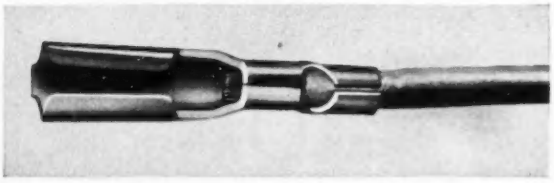
Performance of these miniature connectors meets exacting requirements for millivolt drop, corrosion resistance, and vibration. They are suited for critical low level circuits or power circuits up to several amperes.

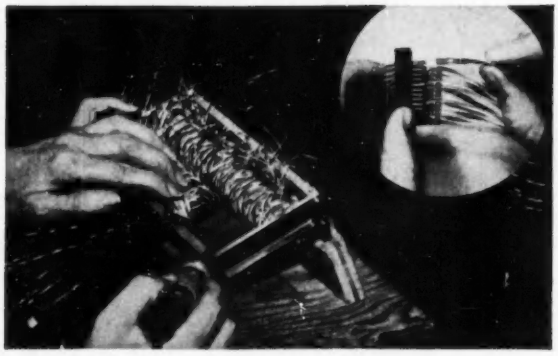
Write to AMP Electronics Division for complete information concerning AMP TAPER TAB RECEPTACLES . . . you will receive data and samples by return mail.

An example of the savings possible with Taper Tabs and Receptacles. This disconnect block in Remington Rand's new electronic computer had more than 1,000 wires soldered to tabs in a space approximately 5" x 9"—an assembly operation requiring two weeks' time. After tabs were modified to taper shape (See picture insert), the same operator can now assemble two blocks per day—a 20 to 1 increase—using A-MP's Taper Tab Receptacle No. 41355. There are neither loose wire ends nor drops of solder in the assembly to cause shorts nor cold or rosin joints to open up in the field. Installation is simply a mechanical operation requiring little operator skill, resulting in greater uniformity.

*For connector plugs and other applications where a round pin is more adaptable, see AMP taper pins.

PHOTO AT RIGHT SHOWS AMP SELF LOCKING TAPER TAB RECEPTACLES BEING APPLIED TO MATING TABS ON A STEPPING SWITCH. LOCKING ACTION GIVES MAXIMUM ELECTRICAL AND MECHANICAL SECURITY . . . CONNECTIONS ARE SUITABLE FOR CRITICAL LOW LEVEL CIRCUITS.





World War II Veteran

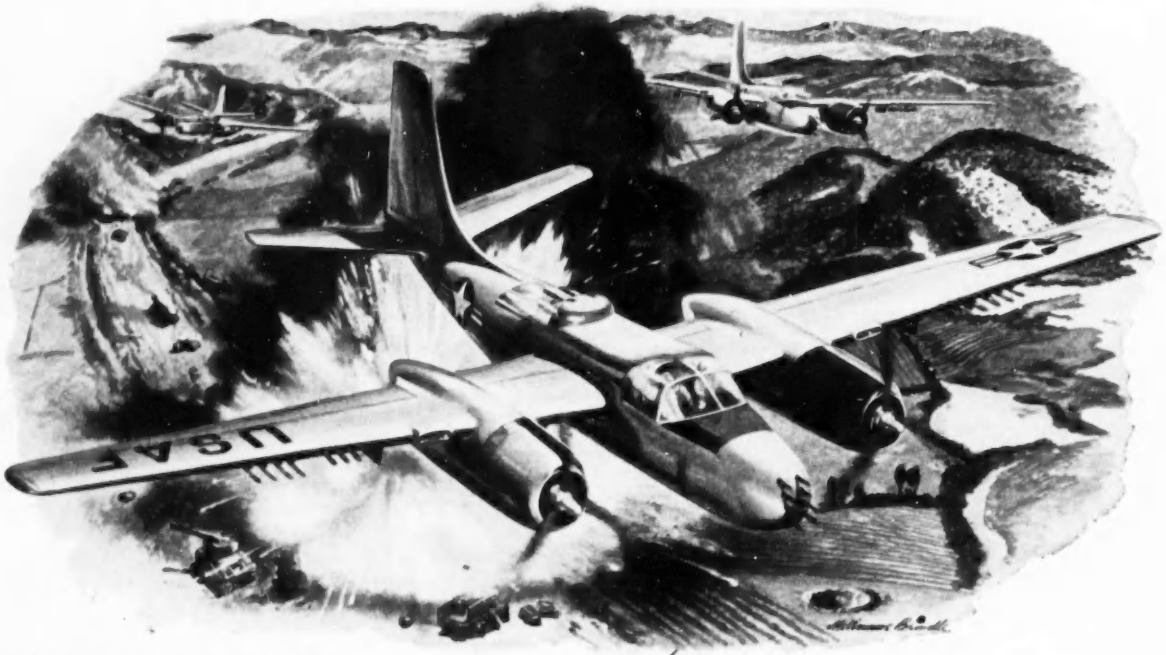
holds its own in the new jet age

the Douglas B-26 Invader

During World War II, over both Europe and the Pacific, the Douglas B-26 Invader spearheaded major allied advances. It was still the standard USAF light bomber when war broke out in Korea.

Laminar-flow, high-speed wing design gives Invader the speed and maneuverability of a piston-engine fighter. With 3-man crew and 6,000-lb. bomb load, combat radius is over 900 miles. Firepower is crushing... sixteen .50 caliber machine guns, fourteen of them in the nose and wings. In Korea, despite the advent of fast new jets, Invader's agility and heavy armament have made it a mainstay in advanced, low-level ground support of our troops.

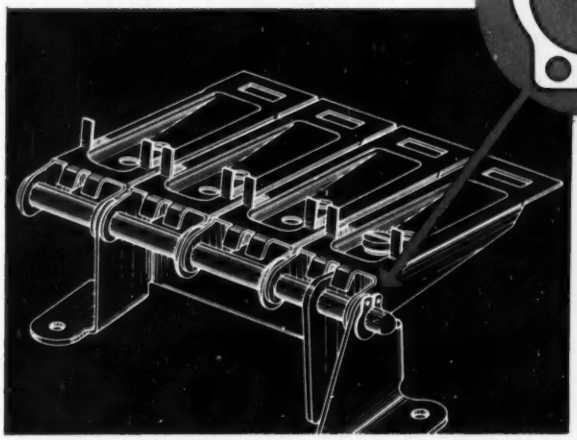
Performance of the B-26 Invader is another example of Douglas leadership. *Faster and farther with a greater payload* is a basic rule of Douglas design.

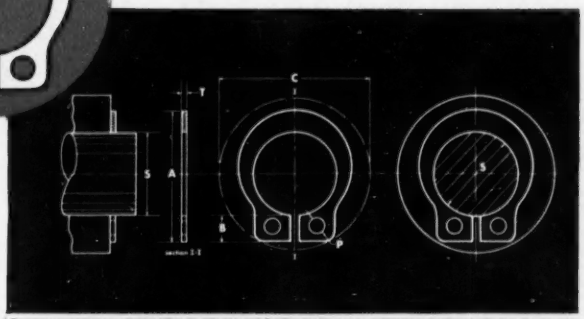


Enlist to fly in the U. S. Air Force

Depend on *DOUGLAS* **First in Aviation**

New Waldes Truarc GRIP Ring requires no groove, holds fast by friction, can be used over and over again





Ring # 5555		5555-12	5555-13½	5555-18	5555-25	5555-31	5555-37
SHAFT DIAMETER	Fract. Equiv. S	1/8"	—	3/16"	1/4"	5/16"	3/8"
	Dec. Equiv. S	.125	.136	.187	.250	.312	.375
	TOL.	±.002	±.002	±.002	±.002	±.003	±.003
RING DIMENSIONS	Thickness T	.025	.025	.035	.035	.042	.042
	TOL.	±.0015	±.0015	±.002	±.002	±.002	±.002
	Length A	.268	.285	.364	.437	.553	.626
	Lug B	.078	.078	.097	.097	.141	.141
	Hole P	.042	.042	.042	.042	.078	.078
	Min. Ring Clear C	.33	.34	.44	.50	.67	.73
Approx. Ultim. Thrust Load (lbs)		20	20	25	35	50	60

The Waldes Truarc Grip Ring is a new, low cost fastener that provides a positioning shoulder secure against moderate thrusts or vibration. Installed on a straight ungrooved shaft, the Truarc Grip Ring can be assembled and disassembled in either direction with Truarc pliers.

The Grip Ring can be installed tightly against a machine part in order to take up end-play. The basic Truarc design principle assuring complete circularity around periphery of the shaft and the ring's unusually large radial width combine to exert considerable frictional hold against axial displacement. The ring can be used again and again.

Find out what Waldes Truarc Retaining Rings can do for you. Send us your drawings. Waldes Truarc engineers will give your problems individual attention without obligation.

SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,418,053; 2,420,921; 2,428,341; 2,439,765; 2,441,846; 2,455,185; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

SA-115

Waldes Kohinoor, Inc.,
47-16 Austel Place, L.I.C. 1, N. Y.

☐ Please send me sample Grip-Rings (please specify shaft size _____)

☐ Please send me the complete Waldes Truarc catalog.

(PLEASE PRINT)

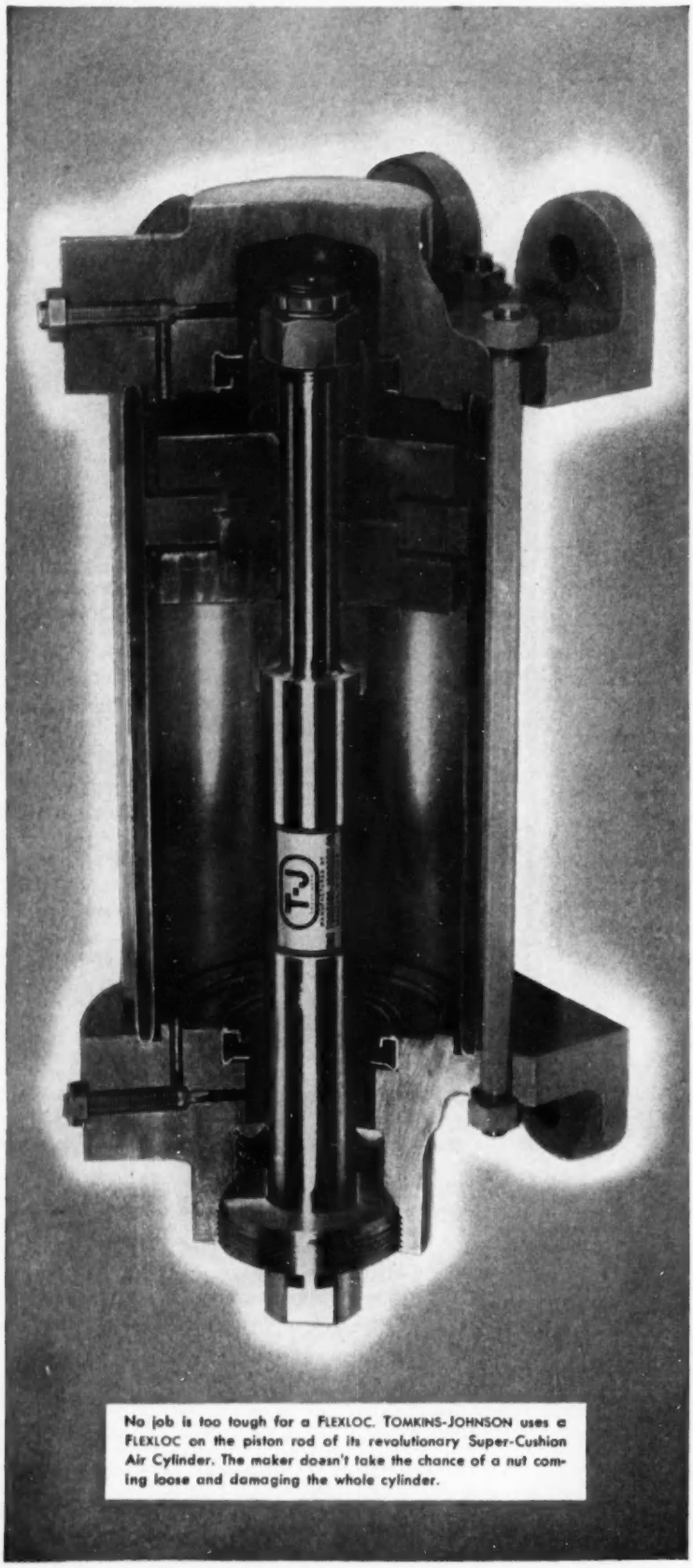
Name _____

Title _____

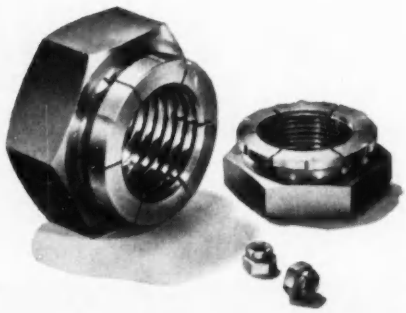
Company _____

Business Address _____

City _____ Zone ____ State _____



No job is too tough for a FLEXLOC. TOMKINS-JOHNSON uses a FLEXLOC on the piston rod of its revolutionary Super-Cushion Air Cylinder. The maker doesn't take the chance of a nut coming loose and damaging the whole cylinder.



What FLEXLOC locknuts do for you

FLEXLOCs eliminate complicated, time-consuming methods of locking threaded fasteners. They offer simpler, faster application and safer, more dependable locking than plain nuts and lockwashers, castellated nuts and cotter pins, or nuts and jam nuts. And they won't work loose.

The reasons for all this are plain. FLEXLOCs are one piece—nothing to assemble, come apart, lose or forget. FLEXLOCs are all metal—have higher tensile than most other locknuts and are not affected by temperatures to 550°F. FLEXLOCs are both stop and locknuts—don't have to seat to lock, and stay put anywhere on a threaded member as soon as their locking threads are fully engaged.

SPS can deliver any quantity of FLEXLOCs in a wide range of sizes. Stocks are carried by industrial distributors everywhere. Write for literature. SPS, Jenkintown 55, Pa.

FLEXLOC®

LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

Our Fiftieth Year : A START FOR THE FUTURE

Now! get faster, easier starts...

FOR ANY GAS OR DIESEL ENGINE

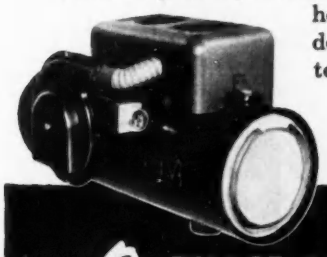
even at 65° below!

WITH South Wind PRE-HEATING SYSTEMS

One heater provides *all 3!*... Engine starting, cab heating —defrosting!

Another Revolutionary South Wind First! With South Wind Pre-Heating Systems you get the same quick, reliable engine starting for any gas or diesel engine that major aircraft and military vehicles enjoy! First choice of engineers and maintenance men, they're designed to make starting easier at all temperatures—*even 65° below!*

Never Before such compactness, such power, such adaptability! *Heater* provides engine preheating, cab heating and defrosting! Economical, too! South Wind Pre-Heating Systems reduce battery drain by reducing starting torque—cut the cost of starting aids. Eliminate the shock loads imposed by brute-force starting methods. Lower maintenance costs—prolong engine life!



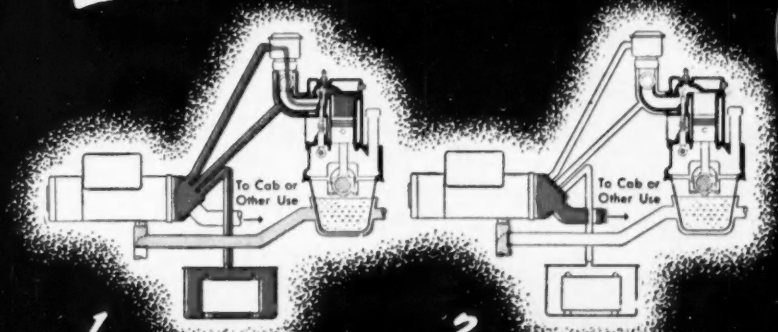
Model 978 MF
20,000 BTU/hr.
fresh air output
Total output, 30,000 BTU/hr.

Clean, Dry Air is delivered to engines by South Wind Heaters! They permit use of optimum viscosity lubricants and assure normal lubrication at all times. Remove moisture—inhibit sludge formation and freeze-up of engine accessories, too.

A Model for Every Requirement! South Wind Heaters meet every *internal* or *external* preheating need. They include units of 20,000, 30,000, 50,000, 60,000, 100,000, 200,000, 600,000, and 700,000 BTU/hr. capacities.

An experienced staff of South Wind Field Engineers is ready to consult with you on any preheating problem. Write today to South Wind Division, Stewart-Warner Corp., Indianapolis 7, Ind.

2-PHASE EXTERNAL PRE-HEATING

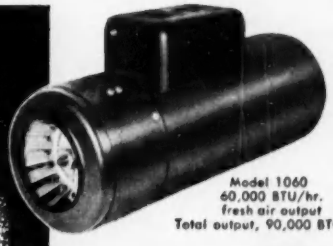


1

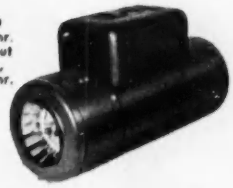
Pre-Heat Phase. Clean, *dry* hot air is applied to the exterior surface of the carburetor and intake manifold, and to the battery, by the use of shrouds. The oil sump is heated in like fashion by hot gases from the heater exhaust. (Clean, hot air which enters the air intake is, in some cases, provided for the starting phase.)

2

Operational Phase. After starting engine, clean, hot air from the heater is diverted to cab for personnel heating, defrosting and other uses. (If the application demands, part of this air can be used to provide continuous heat for battery and/or air induction system.) Heater exhaust is diverted directly to atmosphere.



Model 1060
60,000 BTU/hr.
fresh air output
Total output, 90,000 BTU/hr.



Model 1030
30,000 BTU/hr.
fresh air output
Total output,
50,000 BTU/hr.

A PRODUCT OF SW STEWART WARNER

South Wind

PERSONNEL HEATING
ENGINE AND EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING

Engine parts you can take for granted

...whether it's a reciprocating engine

...or a jet

OVER 50 years experience in research and manufacture are behind Thompson's ability to produce precision-engineered parts for today's airplanes.

Throughout the long history of flight, Thompson has played an increasingly-important role in the design, development and manufacture of parts made to the most exacting specifications where tolerances are measured in .0001 inches. And today, airplane engine manufacturers count on Thompson for precision-engineered parts, such as valve seat inserts and piston pins for reciprocating engines and a wide variety of exacting parts for jet engines.

Engine manufacturers know they can count on Thompson for exact tolerances, maximum performance and service, and dependability of supply. You, too, can count on Thompson. If you are having trouble with engine parts, or if you need a better or more dependable supplier, write or call Special Products Division, Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, O.

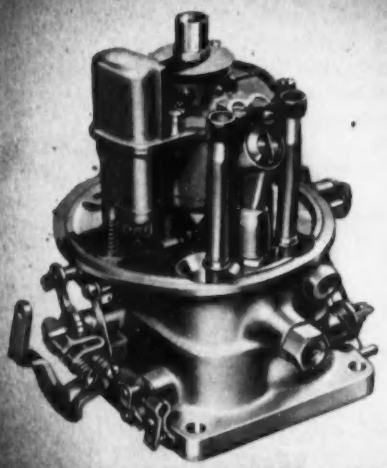
You can count on

Thompson Products

SPECIAL PRODUCTS DIVISION
2196 Clarkwood Road • Cleveland 3, Ohio

First and Only Fuel-and-Ignition Combination

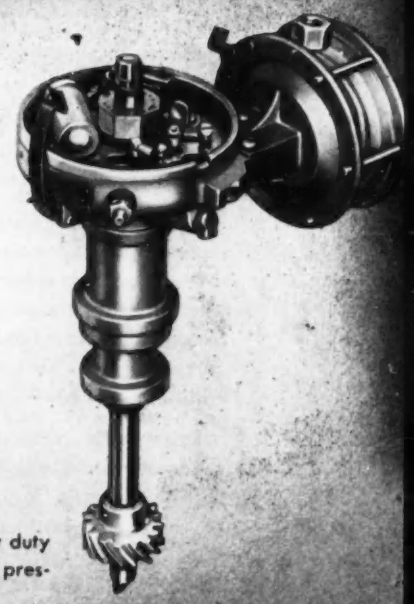
Another **HOLLEY** *engineering first!*



HOLLEY CENTRI-QUAD

Designed to add horsepower to present day engines, the Holley Centri-Quad is the only carburetor to combine four barrels into one carburetor with one float assembly. The concentric design prevents loading or starving during sharp turns and fast stops and starts. The Centri-Quad is designed for the same basic air cleaner installations as used on the Centri-Flo.

with



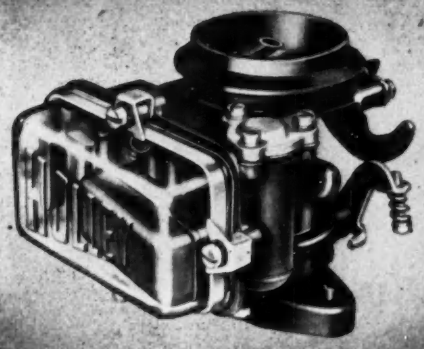
HEAVY DUTY PRESSURE DISTRIBUTOR

Designed for use on maximum horsepower engines, the heavy duty distributor is a dual-diaphragm "big brother" to the standard pressure distributor.

-FLO

designed with all im-
center line of the fuel
smooth, uninterrupted
during fast stops and starts and
sharp turns. The unique carburetor and air-cleaner
combination allows lower hood lines—meets the modern
styling trends.

or



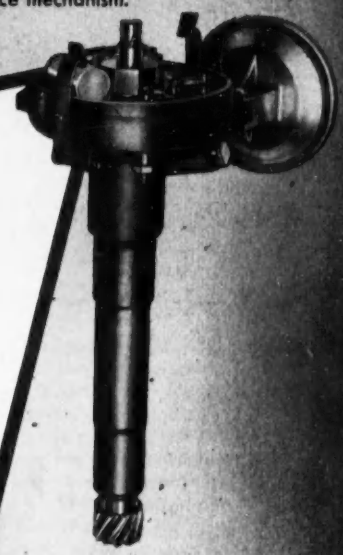
HOLLEY VISI-FLO

The clear glass fuel bowl and the replaceable metering unit features of the Visi-Flo revolutionized carburetor service. This compact carburetor — only four inches high—can be used where limited overhead space ordinarily requires special manifold design.

PRESSURE DISTRIBUTOR

Using pressures that exist within the carburetor, the Holley pressure distributor meters sparks in exact relation to power requirements and fuel flow. It provides quicker, smoother performance and greater fuel economy. It is the only distributor now available that eliminates the need for a centrifugal advance mechanism.

with



SYNCHRONIZED CARBURETORS AND DISTRIBUTORS GIVE MAXIMUM ENGINE PERFORMANCE

Holley was the first to unite the carburetor and distributor into a coordinated team. The Holley pressure distributor operates from pressures generated within the carburetor, and meters spark in direct relation to power requirements and fuel flow.

Each of the Holley carburetors on this page are designed to produce maximum engine performance when installed with a Holley pressure distributor. There is a combination available for nearly every engine now in use or now being designed for the automotive industry.

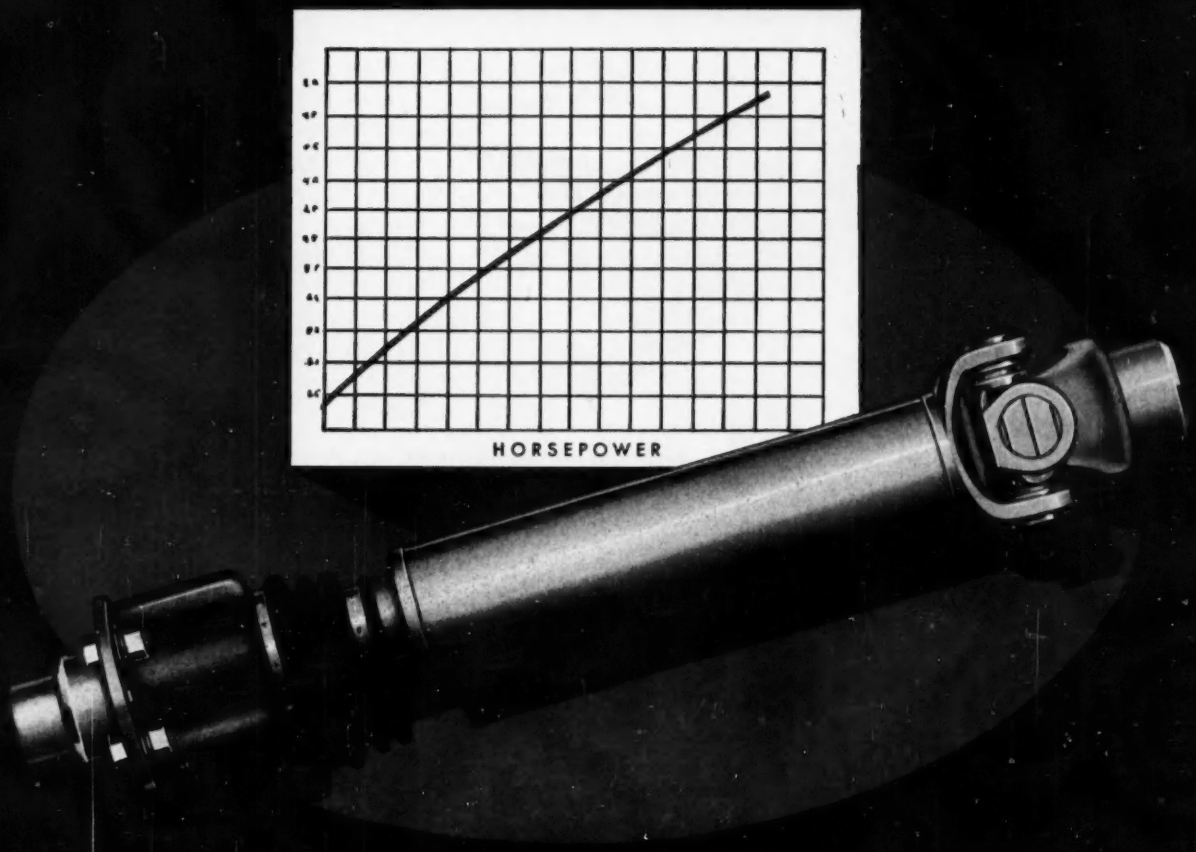
FOR MORE THAN HALF A CENTURY—
ORIGINAL EQUIPMENT MANUFACTURERS
FOR THE AUTOMOTIVE INDUSTRY.

ARE YOU WONDERING . . .

How to do a good job of fuel metering better? Let Holley engineers listen, test, design, and recommend.

HOLLEY
Carburetor Co.
DETROIT 1, MICHIGAN

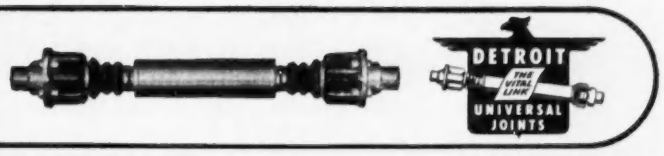
Today's Competition for Horsepower...



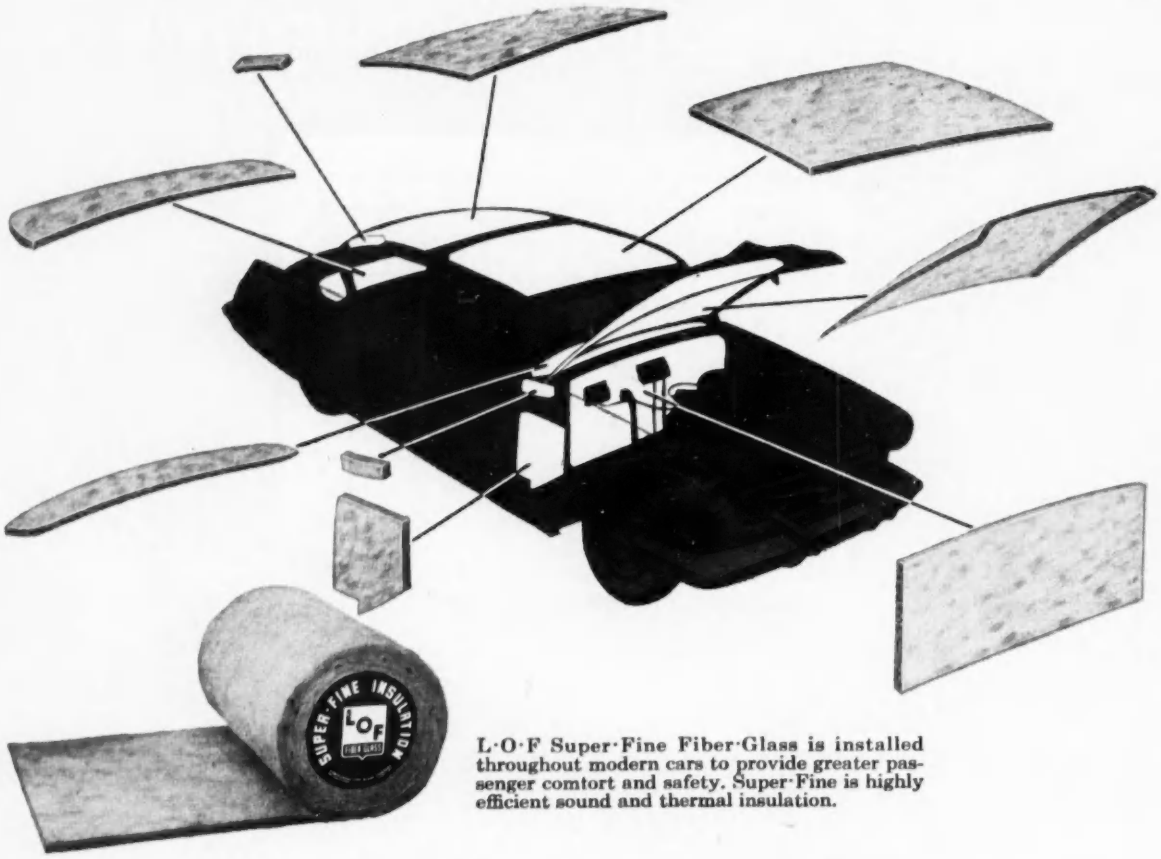
...Puts Universal Joints on the Spot

Car engineers are doing a great job of stepping up the horsepower of today's engines. But every bit of new power puts added strain on universal joints. That's why the extra quality built into "DETROIT" Universal Joints is so important—they're built for today's high torque engines.

DETROIT
UNIVERSAL JOINTS



UNIVERSAL PRODUCTS COMPANY, Inc., Dearborn, Michigan



L·O·F Super·Fine Fiber·Glass is installed throughout modern cars to provide greater passenger comfort and safety. Super·Fine is highly efficient sound and thermal insulation.

Your final step in muting high-frequency engine noise!

The successful effort to quiet an engine begins with attention to moving parts, and ends with a blanket of L·O·F Super·Fine Fiber·Glass installed under the hood and on the fire wall. There are few owner satisfactions to compare with an engine that never speaks above a whisper.

Inherently suited to those applications, L·O·F Super·Fine muffles high-frequency engine noise, tire whine, airstream whistle, helps block heat passage into car body. The glass fibers resist fire, oil, grease and most acids.

Other applications of L·O·F Super·Fine Fiber·Glass —liners in roof, under package trays, on dashboard— further support your continuing effort to offer customers engines that speak only in whispers and auto bodies that offer increased passenger comfort.

On your production lines, featherweight L·O·F Super·Fine is easily handled, quickly applied without lost motion. Of course, it almost goes without saying that you can depend on Libbey·Owens·Ford, with its long automotive experience, to deliver top-quality Super·Fine Fiber·Glass right on schedule.

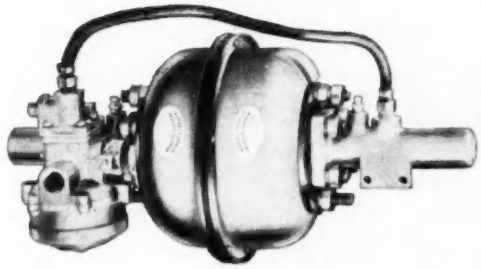
For further information, call L·O·F's Detroit office, 610 Fisher Building, TRinity 5-0080. Or write us for the names of Hoodliner-Kit suppliers. Libbey·Owens·Ford Glass Co., Fiber·Glass Division, 6113 Wayne Building, Toledo 3, Ohio

LIBBEY·OWENS·FORD GLASS COMPANY
FIBER·GLASS DIVISION

LOF GLASS Corrulux FIBER-GLASS

FIBER·GLASS

...thanks to Borg-Warner POWER BRAKES



BW *engineering makes it work*

BW *production makes it available*

Almost every American benefits every day from the 185 products made by

BORG-WARNER

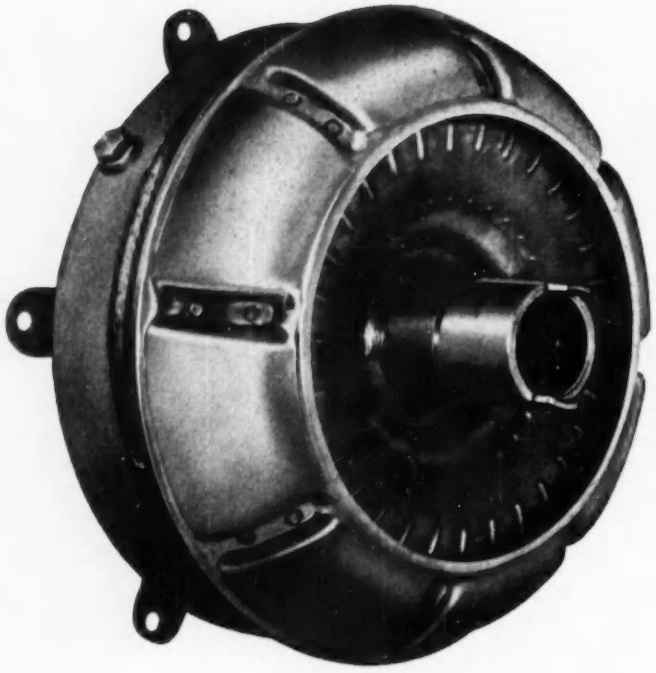
Just a light touch, an *e-a-s-y* pedal pressure, and Borg-Warner power brakes take hold. Instantly. Smoothly. Firmly. Braking power is stepped up—for quicker, surer, safer stops, with a fraction of the effort. This means more efficient braking—plus greater driver comfort, less strain, less fatigue.

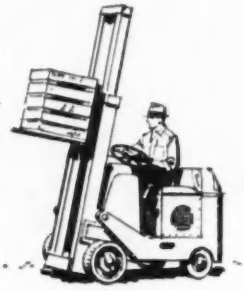
What's more, Borg-Warner power brakes have a minimum of wearing parts, require no lubrication, and are not affected by climatic conditions. That means longer life, lower maintenance costs, greater dependability. Unusually compact, units are easily installed in existing brake systems.

Available for passenger cars, trucks, tractors and trailers, Borg-Warner power brakes are designed, engineered and produced by B-W's Marvel-Schebler Products Division. Another example of how Borg-Warner "designs it better—makes it better." One more way Borg-Warner serves the automotive industry—and the public—every day.

ENGINEERING BW PRODUCTION

THESE UNITS FORM BORG-WARNER, *Executive Offices, Chicago:* ATKINS SAW • BORG & BECK • BORG-WARNER INTERNATIONAL BORG-WARNER SERVICE PARTS • CALUMET STEEL • CLEVELAND COMMUTATOR • DETROIT GEAR • FRANKLIN STEEL INGERSOLL PRODUCTS • INGERSOLL STEEL • LONG MANUFACTURING • LONG MANUFACTURING CO., LTD. • MARBON MARVEL-SCHEBLER PRODUCTS • MECHANICS UNIVERSAL JOINT • MORSE CHAIN • MORSE CHAIN CO., LTD. • NORGE NORGE HEAT • PESCO PRODUCTS • REFLECTAL • ROCKFORD CLUTCH • SPRING DIVISION • WARNER AUTOMOTIVE PARTS WARNER GEAR • WARNER GEAR CO., LTD. • WOOSTER DIVISION





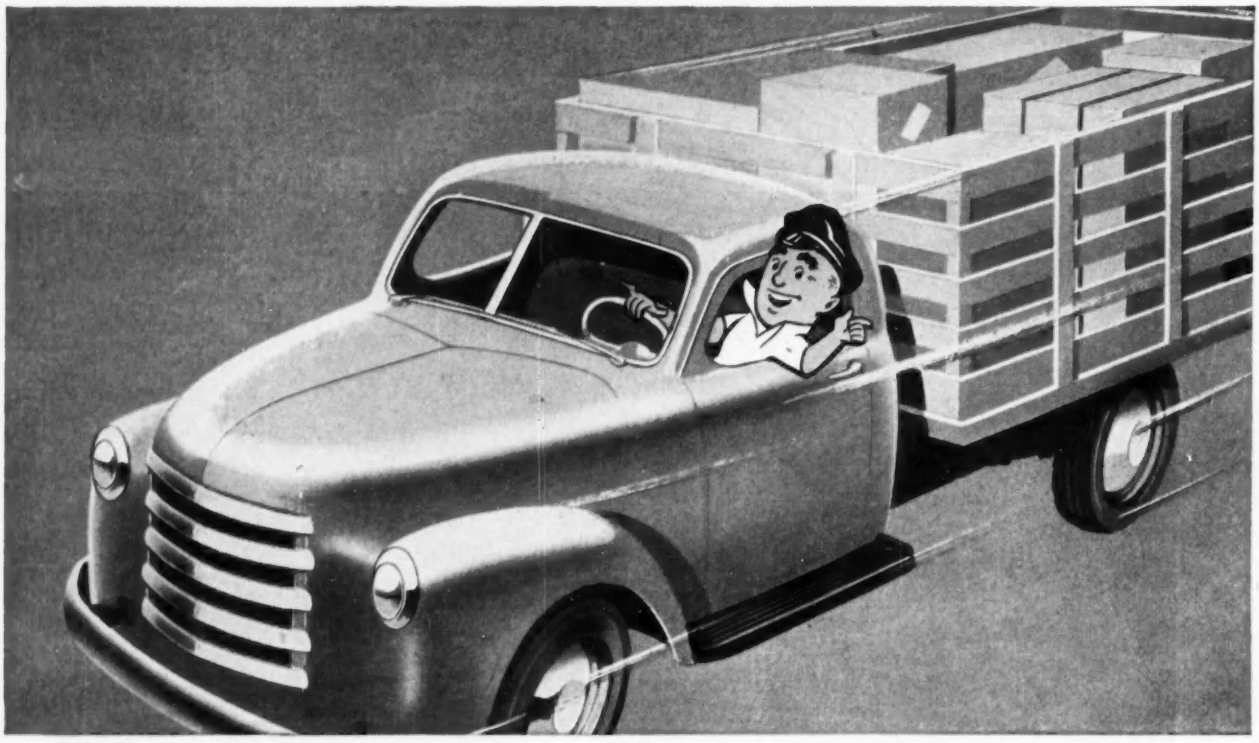
Fine performance is combined with low cost in the Long Torque Converter

LONG MANUFACTURING DIVISION • BORG-WARNER CORPORATION
DETROIT, MICH. AND WINDSOR, ONT.

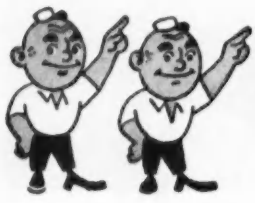
50 Years
of Quality Manufacturing for the Automotive Industry

LONG

TORQUE CONVERTERS • CLUTCHES • RADIATORS • OIL COOLERS



1 **In billions** of miles traveled by millions of trucks, automobiles, buses, and tractors, Bundyweld has established a solid reputation for complete reliability.



You gain even more than safety when you choose Bundyweld Tubing

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

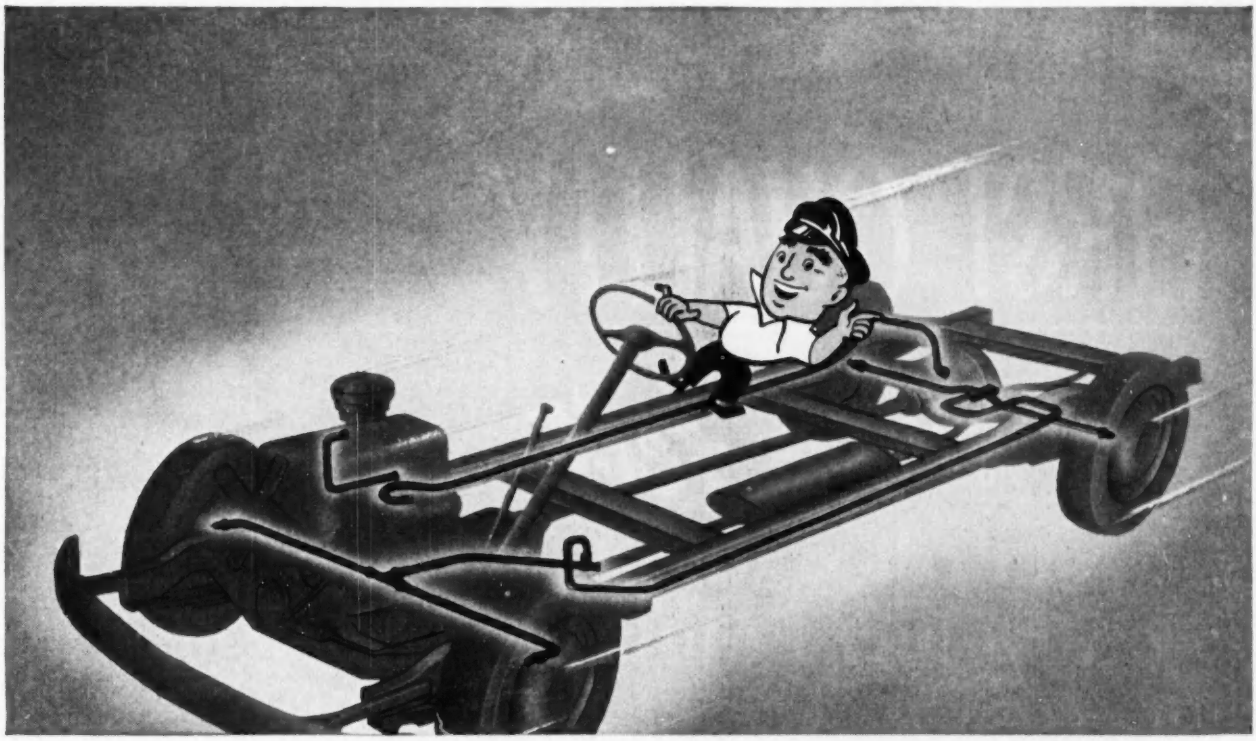
passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East. • ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Los Angeles 58, Calif.,*** Tubesales, 5400 Alcoa Ave.

Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.



2 **Regardless** of the kind of vehicle you're concerned with, you'll gain new peace of mind —and much more—with Bundyweld in your gasoline, oil and hydraulic brake lines.

Safety and Bundyweld Tubing go hand in hand in the automotive industry.

That's been proved by the trouble-free performance of almost 500,000 miles of Bundyweld used in automotive tubing parts in the last twenty years. But you gain even more than safety when you use Bundyweld.

For instance, you get help from skilled tubing engineers who'll work with you to crack tough problems in design, fabrication, or function. As you work with our men, you'll see why we can recommend them as people who know their Bundyweld inside out and understand your problems, too.

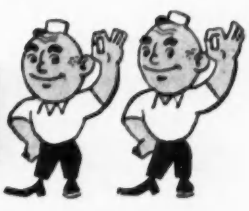
You get the automotive industry's most up-to-date and versatile fabrication facilities working for you. This pays off in parts accurately produced at lowest possible cost, carefully inspected, properly packed for safe transport and economical handling, shipped to arrive exactly when you want them. If your plant's equipped for fabrication you can order Bundyweld in easily handled straight lengths, too.

You get tubing properties no one's ever equaled. Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof. It's lighter, yet stronger —withstands severe shocks and has high fatigue limit.

For tubing that's the standard of dependability in the automotive industry, for engineering help and fabrication facilities you can't beat, come to Bundy, world's largest producer of small-diameter tubing.

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

Bundyweld® Tubing



DOUBLE-WALLED FROM A SINGLE STRIP

FIRST QUALITY

western Felt guards against product failure...

Felt is not "just felt." There is a vast difference in its uniformity, treatment, manufacture and efficiency. Western Felt, for over fifty-three years has not and will not, depart from its policy of maintaining the highest possible quality in material and manufacture. Its products, wherever they may be employed, are your insurance against product complaints due to a Western Felt component part. Here are just a few of its features that you can always depend on: range from wool softness to rock hardness—never loses shape—does not ravel or fray—resists oil, water, heat, age, resilient, flexible, compressible—may be cut to extremely close tolerances for small parts—unsurpassed in uniformity.

Western Felt engineers with decades of experience in the use of felt stand ready to counsel you.

WESTERN Felt WORKS

4035-4117 Ogden Ave.
Chicago 23, Illinois
Branches in all Principal Cities

MANUFACTURERS AND CUTTERS OF WOOL FELTS

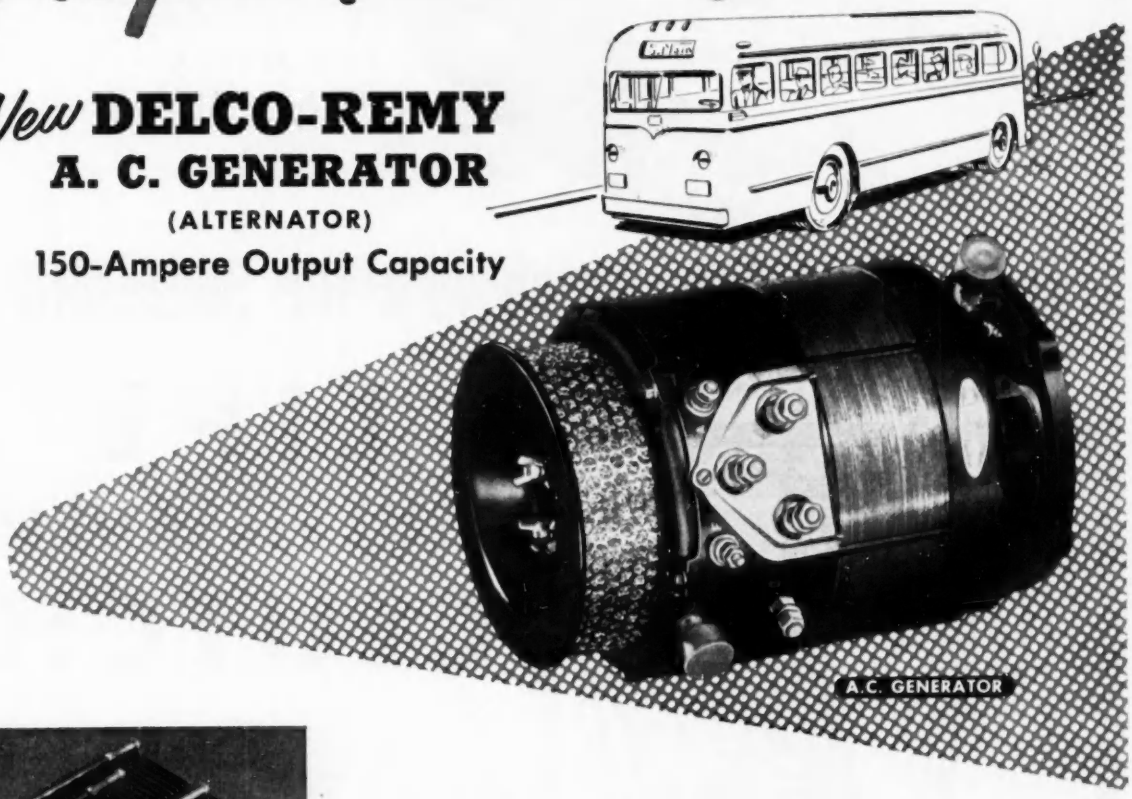
Sheet and roll felt manufactured for special purposes and to meet all S.A.E. and military specifications.

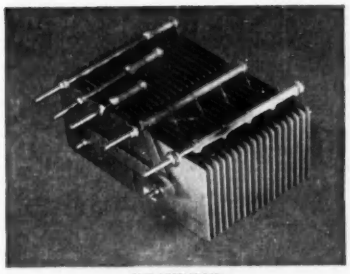
Right for the Job!

New DELCO-REMY A. C. GENERATOR

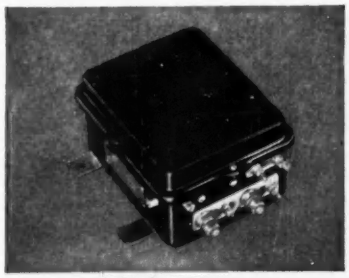
(ALTERNATOR)

150-Ampere Output Capacity





RECTIFIER



REGULATOR

The new Delco-Remy A.C. generator is the heart of a 12-volt A.C.-D.C. electrical system designed specifically for modern buses with fluorescent lighting and extra-heavy electrical loads.

It cuts in at approximately 550 generator rpm and reaches a maximum output of 150 amperes at approximately 1175 rpm.

The new generator not only supplies alternating current for fluorescent lighting, but also ample direct current for the heaviest electrical loads coupled with lengthy engine-at-idle periods.

Impressive features of the new generator are its relatively light weight, its very high output capacity and its ability to operate over a wide range of speeds.

This new Delco-Remy A.C. generator is the result of modern, top-level engineering practice . . . another reason why the makers and users of modern buses have learned to depend on Delco-Remy for advance-design electrical equipment.

DELCO-REMY

Division, General Motors Corporation, Anderson, Indiana

AUTOMOTIVE, TRACTOR AND MARINE ELECTRICAL EQUIPMENT

Standard Grades of Alloy Steel Will Often Do the Job

In many instances you can meet alloy steel requirements with standard grades. Applications, civilian or military, that really require the temperamental special grades are relatively few.

In the "special" bracket are the jobs where resistance to heat, corrosion, or low-temperature impact is the prime consideration. Here, generally speaking, you have to call upon other than standard grades. Bethlehem is usually able to supply them.

But wherever feasible, it is to your advantage to specify standard analyses—mainly for these reasons:

1. Standard grades meet the usual requirements for hardness, strength, and ductility.

2. With standard grades, chemical ranges usually fall within closer limits than those of special grades; hence you can use the conventional, more familiar—and often less costly—methods of heat-treating.

3. You can normally buy standard-grade steels in small tonnages, keeping your inventory low. In contrast, the user who orders an other than standard grade must in most instances specify a heat lot.

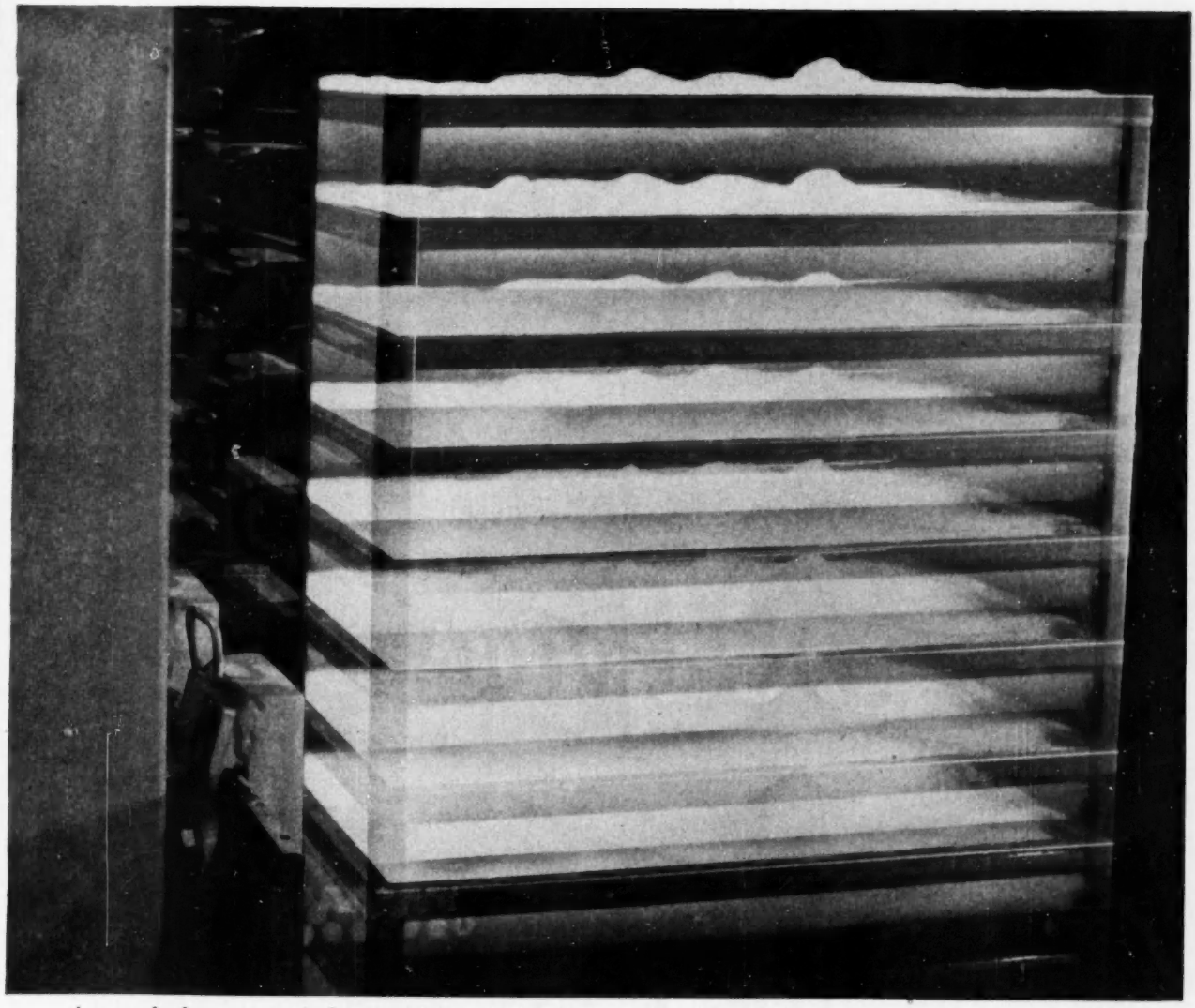
Bethlehem manufactures all AISI grades and special-analysis steels, and the full range of carbon steels. Please remember that we can always furnish the grade you wish, whether standard or special. But if there's any question of choice, anything not quite clear concerning grades and their applications, by all means discuss the problem with our metallurgists. They are always at your service.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

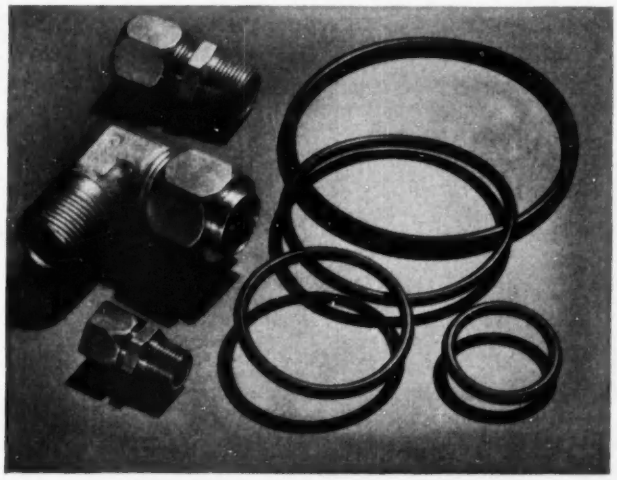
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM ALLOY STEELS

BETHLEHEM STEEL



shows tank of soapy water (suds on top) being raised without a ripple in the water line.



What other Parker products for hydraulic and fluid systems interest you? Triple-lok flare fittings? Ferulok flareless fittings? Synthetic rubber O-rings? Any other products?

THE PARKER APPLIANCE COMPANY
Section 201-M
17325 Euclid Avenue
Cleveland 12, Ohio

Please send me the following information:

☐ Hydraulic control valve Bulletin 1551 A
☐ Information about these other Parker products:

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Send for catalog of complete information about Parker hydraulic control valves. If you'd like to know more about other Parker products, list them on the coupon or write to the above address.

Craftsmanship

THE BOHN SYMBOL OF QUALITY

Pistons, Bearings, Forgings, Extrusions, Castings, Ingots, Refrigeration Products, Aircraft Parts, Automotive Replacement Parts. Each product recognized as the standard of quality.

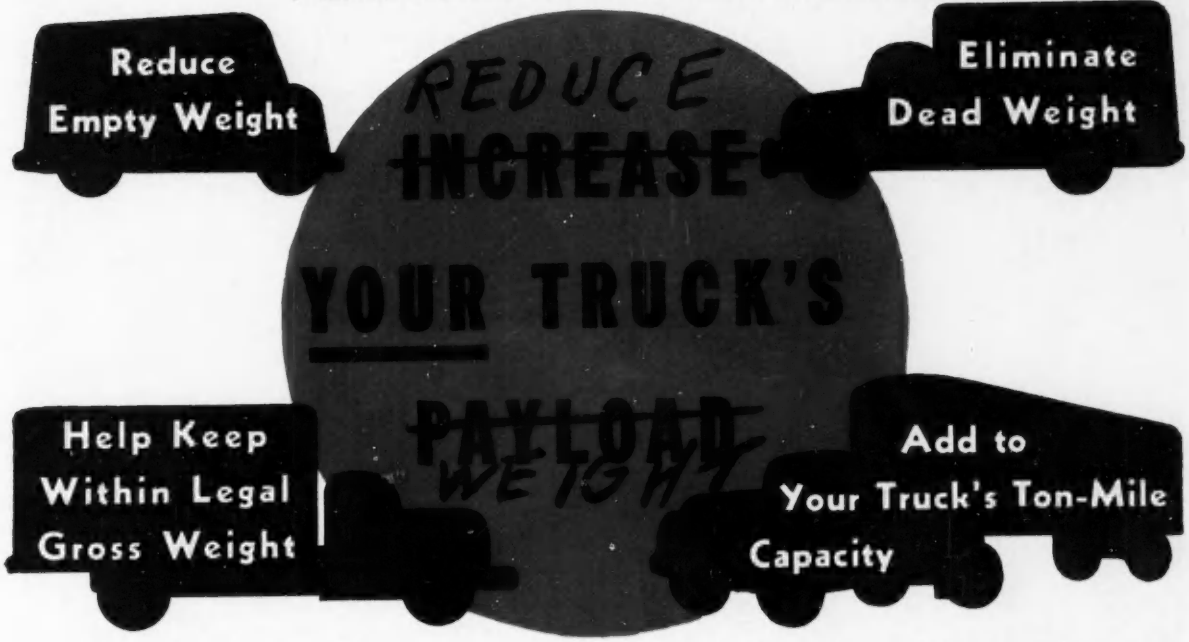
BOHN

ALUMINUM & BRASS CORPORATION

General Offices: LAFAYETTE BLDG.
DETROIT 26, MICHIGAN

FLASH .... FLEET OPERATORS ARE PAYING A PREMIUM

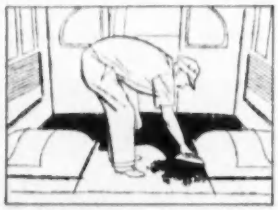
OF ONE DOLLAR PER POUND FOR REDUCED TRUCK WEIGHT



A truck manufacturer says big fleet operators are offering $1.00 per pound for reduced truck weight — and that the use of lighter metals has reduced weights down to their lowest achievement point — within acceptable standards of life and wear. Because MECHANICS Roller Bearing UNIVERSAL JOINTS truck PROPELLER SHAFT is pounds lighter than other joints and shafts of comparable torque capacity — you can reduce the weight of *your* truck by specifying MECHANICS. Let MECHANICS engineers help reduce the weight and increase the payload capacity of *your* truck — and give it a competitive weight advantage — with a MECHANICS Roller Bearing UNIVERSAL JOINTS truck PROPELLER SHAFT application.

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner • 2022 Harrison Avenue, Rockford, Illinois

Setting safer paths for little feet



The designers and manufacturers of America's school buses place great emphasis on all details pertaining to passenger safety. Safe, non-slip flooring is one of the essentials—and Superior Coach Corporation at Lima, Ohio, uses a 3M Adhesive to anchor floor matting to the steel floors of their school buses.

Superior has standardized on a 3M rubber-based adhesive for this operation because they need fast application and a quick, strong bond that will stand up under vibration, temperature changes and strong cleaning solutions.

See what adhesives can do for you . . .

3M's rubber-based adhesives provide a fast, low-cost way of joining a variety of materials. Like to see some actual examples of what other companies are doing with 3M adhesives? Ask your 3M salesman for a copy of our new Design Handbook, or write today to 3M, Dept. 911, 417 Piquette Ave., Detroit 2, Mich.

3M COMPANY

ADHESIVES•COATINGS•SEALERS

MINNESOTA MINING AND MANUFACTURING COMPANY
ADHESIVES AND COATINGS DIVISION • 417 PIQUETTE AVE., DETROIT 2, MICHIGAN
GENERAL SALES OFFICES: ST. PAUL 6, MINN. • EXPORT: 122 E. 42 ST., N.Y. 17, N.Y. • CANADA: LONDON, ONT.

MAKERS OF "SCOTCH" BRAND PRESSURE-SENSITIVE ADHESIVE TAPES • "SCOTCH" BRAND SOUND RECORDING TAPE • "SCOTCHLITE" BRAND REFLECTIVE SHEETINGS • "3M" ABRASIVE PAPER AND CLOTH • "3M" ADHESIVES AND COATINGS • "3M" ROOFING GRANULES • "3M" CHEMICALS

ENGINE BUILDERS:

CUT THE COST OF chrome plated oil rings IN HALF !

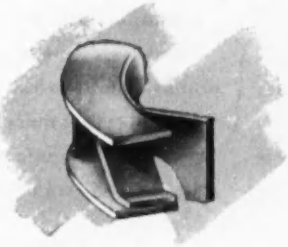
This new Muskegon CSR-200 is a brand new multiple piece ring that combines the advantages of chrome plating and *Unitizing*, at a remarkable price—half the cost of chrome plated cast iron oil rings.

By chrome plating the rails, Muskegon brings you a ring that virtually eliminates scuffing, reduces engine rejects, increases oil economy and reduces ring wear, bore wear and friction. And by applying its patented "Unitizing" process, Muskegon delivers the multiple pieces cemented together with special adhesive which dissolves completely during the first engine run, leaving the pieces separated and free to conform to cylinder contours. Use it on your assembly line like a one-piece ring.

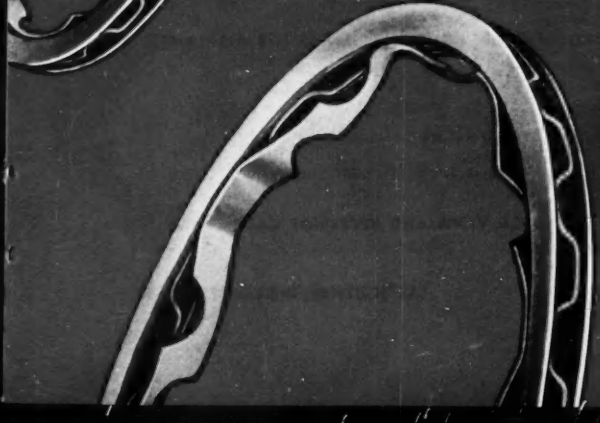
Test these unbreakable, all-steel CSR-200 rings in your own engines, in your own laboratories. See for yourself the extra efficiency, extra economy they provide. Write us, today.

Multiple pieces handle like a one-piece ring. Rails and spacer are correctly assembled and "Unitized" with adhesive cement.

Adhesive disappears during first engine run. Pieces separate to conform to cylinder contours.



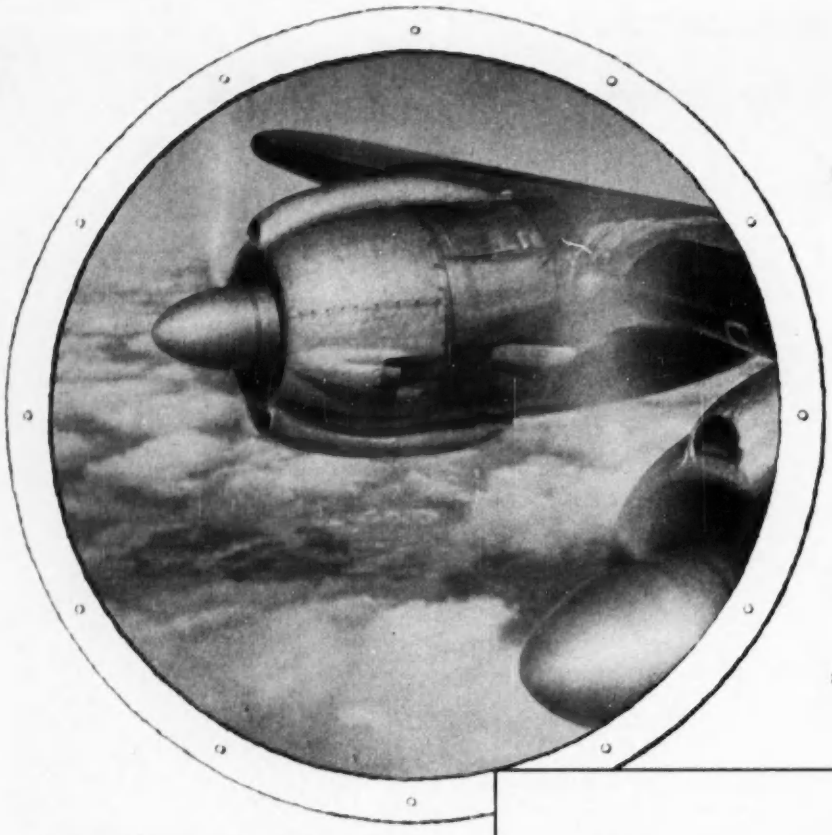
Heavy duty expander assures perfect fit. Tight seal conserves oil, increases engine efficiency.



MUSKEGON
Piston Rings

MUSKEGON PISTON RING CO.
MUSKEGON, MICHIGAN
PLANTS AT MUSKEGON AND SPARTA

DETROIT OFFICE: 521 New Center Bldg., Telephone Trinity 2-2113



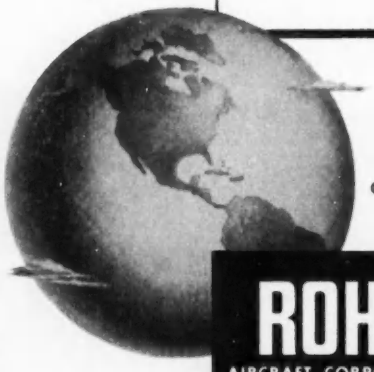
TIME FLIES -do you?

Time is always flying. You can save some of your time by flying, too. Yes, ride the airlines regularly. You'll save moments, minutes, days, weeks to use as you choose—for business or pleasure. Next time... save time... *your* time. Fly!

You're looking out the window of a TWA Constellation at the Rohr-built "power packages" on the wing. For the Lockheed Constellation and other great airplanes, Rohr manufactures and assembles the engine mount, cowl panels, ducts, exhaust system, tanks, and other units which transform a Wright engine into a complete, ready-to-install "power package."

power packages by

ROHR



WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES

ROHR AIRCRAFT CORPORATION CHULA VISTA AND RIVERSIDE CALIFORNIA

Need a high capacity bearing that's compact?

here's how leading chain saw manufacturers get it with NEEDLE BEARINGS

Leading manufacturers of chain saws rely on Torrington Needle Bearings because of their high capacity and their small size.

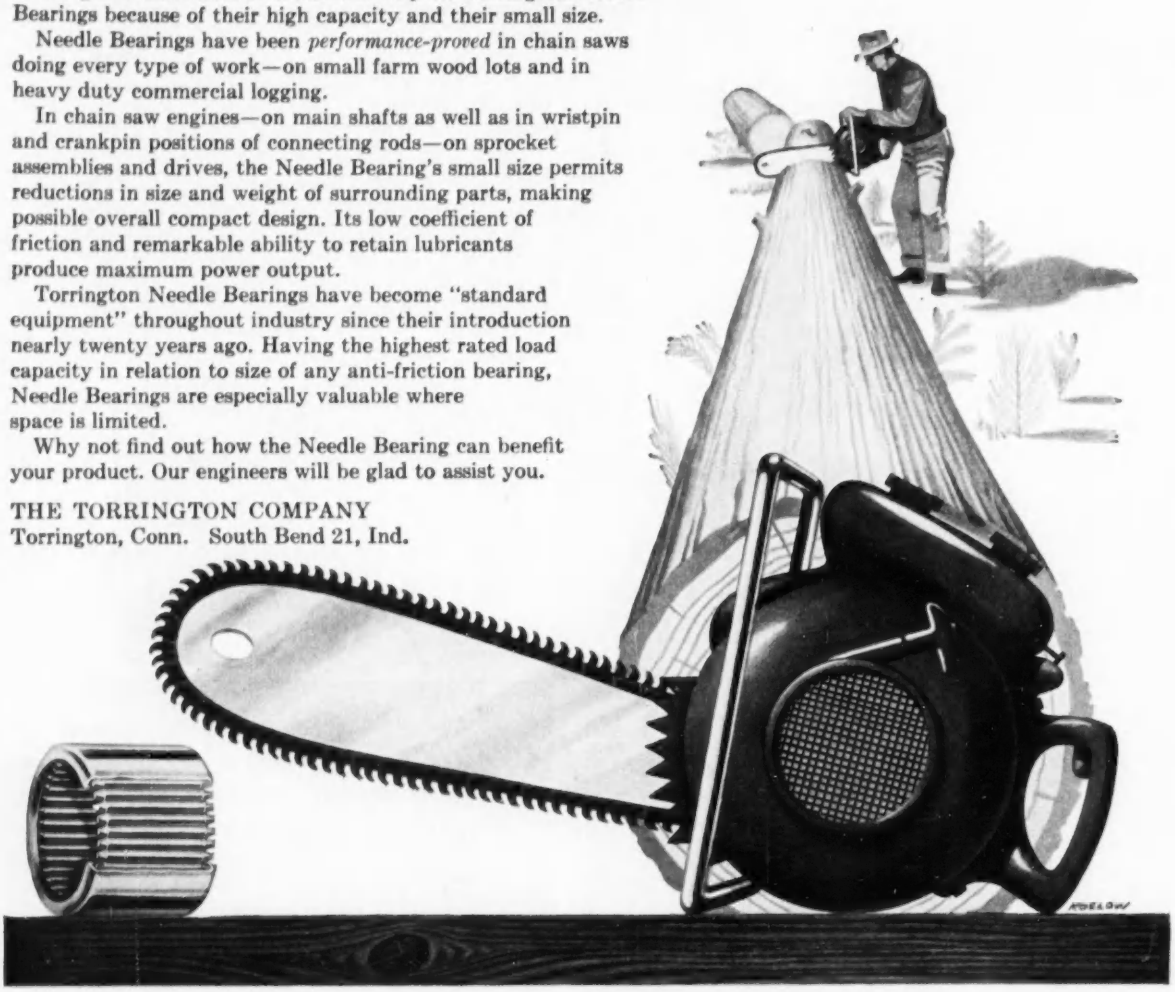
Needle Bearings have been *performance-proved* in chain saws doing every type of work—on small farm wood lots and in heavy duty commercial logging.

In chain saw engines—on main shafts as well as in wristpin and crankpin positions of connecting rods—on sprocket assemblies and drives, the Needle Bearing's small size permits reductions in size and weight of surrounding parts, making possible overall compact design. Its low coefficient of friction and remarkable ability to retain lubricants produce maximum power output.

Torrington Needle Bearings have become "standard equipment" throughout industry since their introduction nearly twenty years ago. Having the highest rated load capacity in relation to size of any anti-friction bearing, Needle Bearings are especially valuable where space is limited.

Why not find out how the Needle Bearing can benefit your product. Our engineers will be glad to assist you.

THE TORRINGTON COMPANY
Torrington, Conn. South Bend 21, Ind.

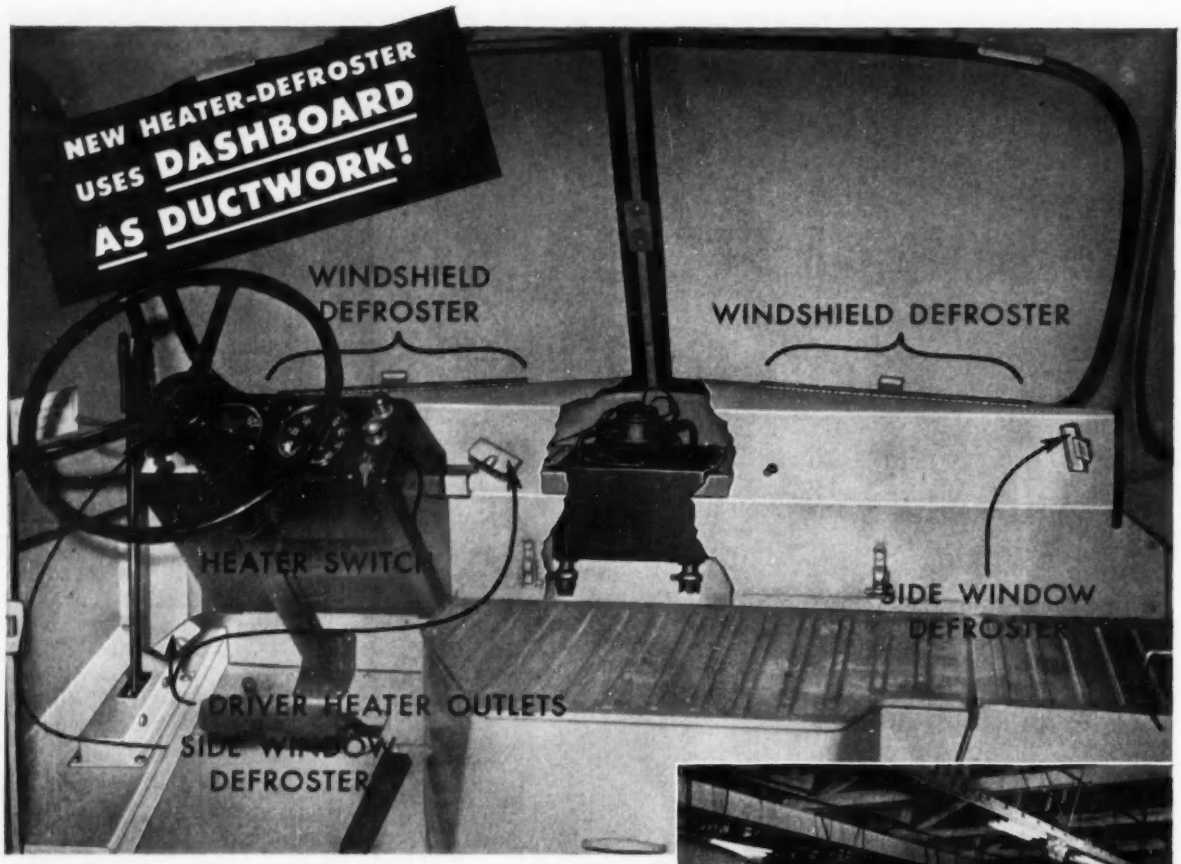


TORRINGTON NEEDLE BEARINGS

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

Trade-marks of leading chain saw manufacturers whose products enjoy the benefits of the Needle Bearing.

HOMELITE CORPORATION · Mall · LG · CLINTON · McCULLOCH McC CHAIN SAWS · POULAN · TITAN CHAIN SAWS · DISSTON · REED PRENTICE CORP



Engineered by EVANS

FOR INSTALLATION ON THE TRUCK ASSEMBLY LINE

This remarkable heater-defroster is a fine example of the advantages of Evans custom engineering service. Working hand in hand with the customer's engineering department, our engineers produced a unit radically different in concept that solved a difficult heating and ventilating problem. The Evans organization is staffed to engineer units to specification, organized to build prototypes quickly, equipped to conduct precision tests to latest A.S.H.V.E. procedures. If your needs are for high performance,–ruggedly constructed equipment—it will pay you to consult Evans Products Company, Heating & Ventilating Division. Dept. Z11, Plymouth, Mich.

EVANS

CUSTOM HEATERS

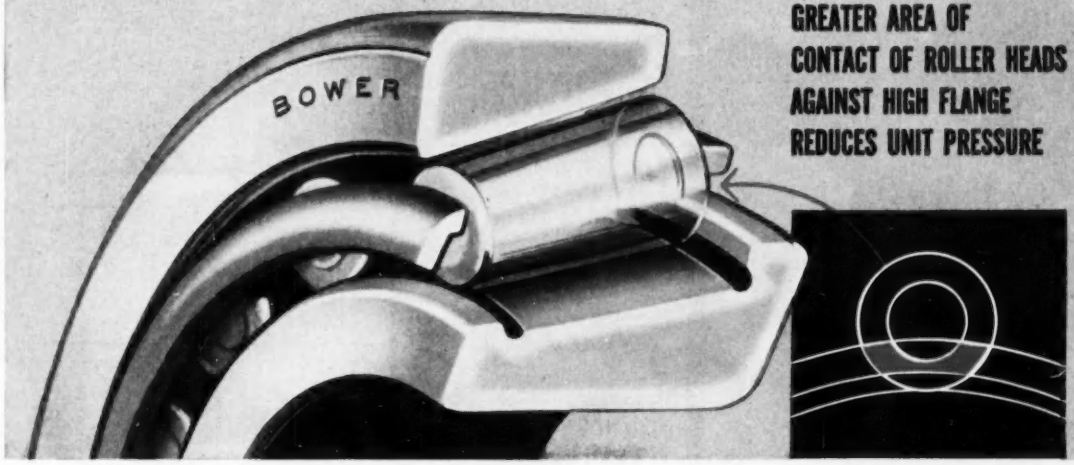
BALANCED HEATING AND VENTILATING SYSTEMS FOR EVERY TRUCK AND BUS

Evans engineering brings you

OUTSTANDING ADVANTAGES LIKE THESE

- Heater-Defroster is an integral part of the body construction.
- Unit heats driver position, entire body compartment and windshield area with only 5% variation between rear door and front door.
- Oversize defroster vents, in conjunction with built-in system of ductwork, perform triple service—heating, defrosting, and pressurizing.
- Compact powerful heater delivers 20,000 Btu output at 175 CFM, with only 7 amp. draw on a six volt system.
- Heater unit completely protected—out of sight yet readily accessible for service—on top of engine position permits extremely short water lines.

Bower spher-o-honed design increases bearing life



GREATER AREA OF CONTACT OF ROLLER HEADS AGAINST HIGH FLANGE REDUCES UNIT PRESSURE

Bower engineers have incorporated many basic refinements into the design of Bower tapered roller bearings which cut maintenance to a bare minimum—increase efficiency. One of the most important of these is the *exclusive* feature illustrated above. Note that the flange at the large end of the cone is *higher*—providing a greater contact area for the roller heads. This greatly reduces wear, improves roller alignment and minimizes resultant "end play". Also note the larger oil groove, providing positive lubrication to the roller heads.

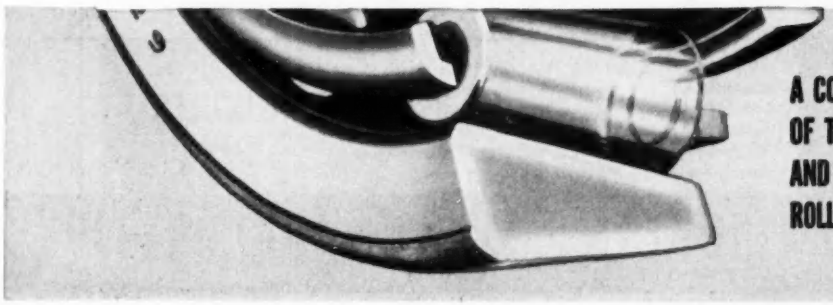
Other important Bower features which increase bearing life and dependability are generated spherical roll-heads, and smooth, precision-honed races. And Bower bearings are known throughout industry for materials and workmanship of highest quality.

Whether your product is in full production or still in the planning stage, you'll be wise to call in a Bower engineer now. He'll show you a wide range of sizes and types to fit any application.

BOWER ROLLER BEARING COMPANY • DETROIT 14, MICHIGAN

BOWER

ROLLER BEARINGS

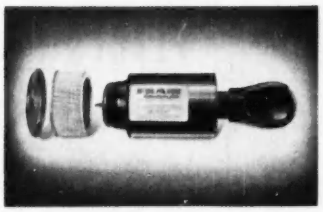


A COMPLETE LINE OF TAPERED, STRAIGHT AND JOURNAL ROLLER BEARINGS

STUDEBAKER

adopts new 99% efficient FRAM Carburetor Air Filter

REDUCED ENGINE WEAR—Studebaker has been using FRAM Oil Filters since 1936. Now new models in most areas of the country also feature the FRAM Carburetor Air Filter as original equipment, for the best and most complete engine protection on the road today.



ECONOMICAL CARTRIDGE DESIGN—The FRAM Carburetor Air Filter offers engine-saving performance never before achieved, plus the convenience of cartridge-type design. The filter cartridge of pleated paper media offers a large effective, filtering area.

New FRAM cartridge-type air filter provides peak efficiency

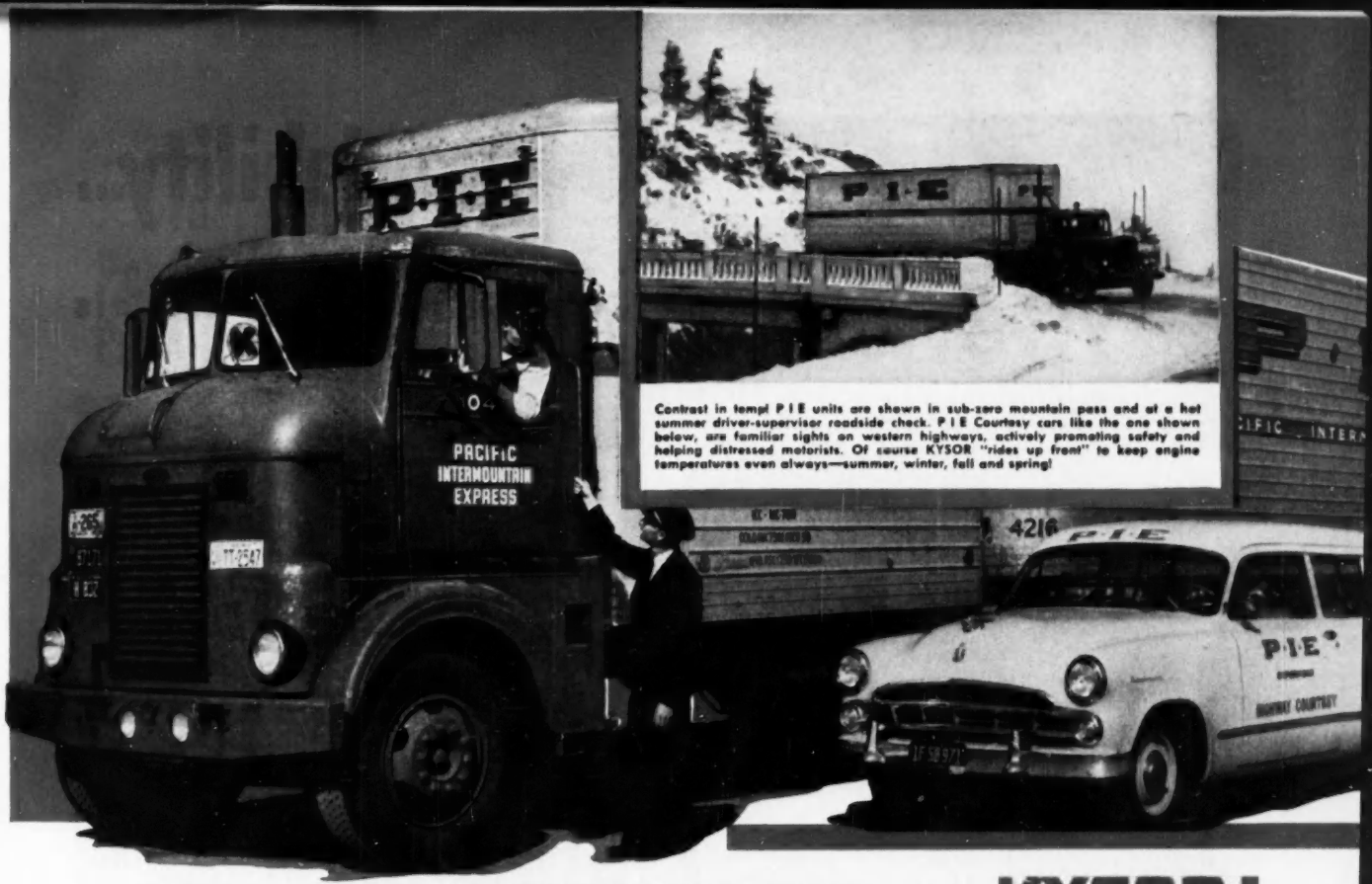
Now Studebaker cars in most areas of the country feature a new concept in air filter design . . . the FRAM Carburetor Air Filter.

The new 99% efficient FRAM greatly reduces engine wear due to airborne abrasives. Cars equipped with FRAM Carburetor Air Filters, properly serviced, can be driven under the most severe dust conditions without damage to vital engine parts.

Matching its outstanding performance is the story of how, employing aviation techniques and experience, FRAM designed and produced this advanced air filter for Studebaker. Working with wooden "mock-ups" FRAM engineers developed a combination filter and silencer to fit and conform to the requirements of 4 different engine compartments. Then long and extensive tests were conducted—dynamometer tests for engine carburetion and induction . . . gruelling road tests in Texas . . . and finally, punishing tests in the FRAM Dust Tunnel. The result—a Carburetor Air Filter unequalled in design and efficiency.

DESIGNED AND TESTED BY FRAM—The new Carburetor Air Filter is one example of how FRAM will undertake and solve filtration problems. The FRAM facilities at Dexter, Michigan, including the giant Dust Tunnel, and the experience of FRAM'S engineering staff are at your disposal for any problem involving oil, air, fuel or water filtration. Write: FRAM CORPORATION, Providence 16, R. I. *In Canada:* From Canada Ltd., Stratford, Ont.

FRAM
OIL • AIR • FUEL • WATER
FILTERS



Contrast in temp! P I E units are shown in sub-zero mountain pass and at a hot summer driver-supervisor roadside check. P I E Courtesy cars like the one shown below, are familiar sights on western highways, actively promoting safety and helping distressed motorists. Of course KYSOR "rides up front" to keep engine temperatures even always—summer, winter, fall and spring!

P·I·E SHARES HONORS *with* KYSOR!

Winner of the Transport Topics Truck Shop Excellence Contest in the 700 trucks and over class, P I E graciously credits Kysor Automatic Radiator Shutters as helping greatly in achieving this honor. Kysor acknowledges with thanks!

"Our tractors are subjected to a wide range of conditions and temperatures from Wyoming through California with 100° temperatures to sub-zero temperatures, and the Kysor shutters have held even engine operating temperatures through it all.

"Even engine operating temperatures, made possible by the Kysor shutters, have increased fuel and oil mileages and have been a contributing factor in increasing engine life to 180,000 miles between overhauls."

Signed: Jack W. Riesing.

Jack W. Riesing

DIRECTOR OF FLEET MAINTENANCE PACIFIC INTERMOUNTAIN EXPRESS CO.

Why should we say more?

KYSOR *Automatic* SHUTTERS

"Wherever Engines Work"

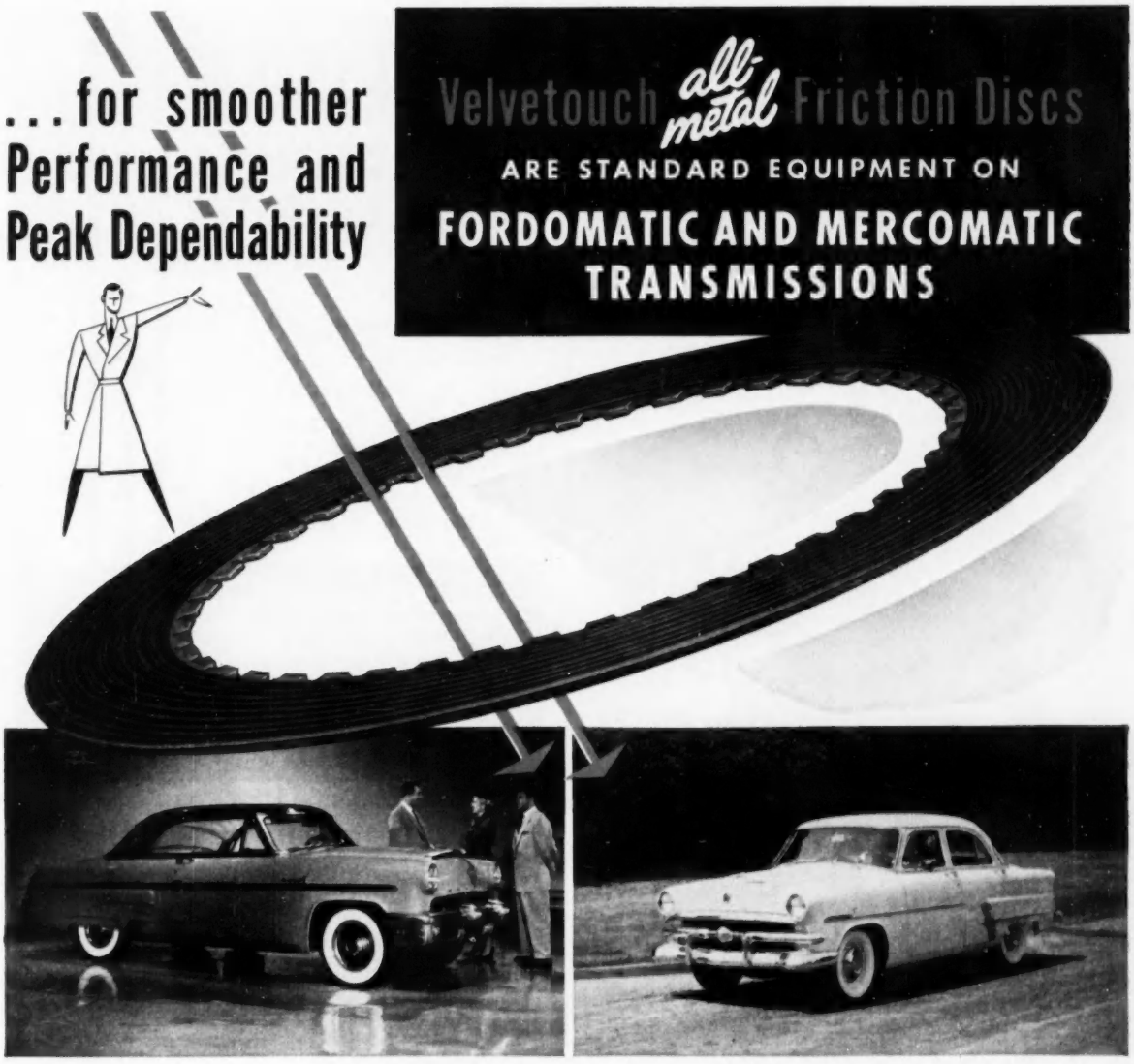
KYSOR HEATER COMPANY • CADILLAC, MICHIGAN

. . . for smoother Performance and Peak Dependability

Velvetouch *all-metal* Friction Discs

ARE STANDARD EQUIPMENT ON

FORDOMATIC AND MERCOMATIC TRANSMISSIONS



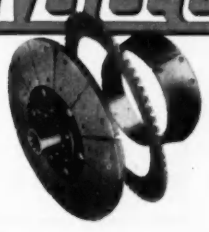
Ford engineers and technicians, in developing the now-famous Fordomatic and Mercomatic transmissions, chose Velvetouch for both units.

All-metal Velvetouch has a long life . . . it insures a smoother, more dependable transfer of power and it won't deteriorate in oil like ordinary friction material.

These field-proven Velvetouch advantages are recognized by experienced design engineers in all industry. For whether it's the clutch in a delicate computing machine, or the automatic-transmission on a multi-ton tractor or tank . . . they know that all-metal Velvetouch is our answer to established operating excellence.

Our technicians will be glad to work with you in solving your clutch and brake problems. Just call our nearest office, or write The S. K. Wellman Co., 200 Egbert Rd., Bedford, Ohio.

Velvetouch



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A REVOLUTIONARY NEW AIR FOR LIGHTWEIGHT VEHICLES!

New small size TU-FLO 300 Compressor Now Brings All the Advantages of Air Braking to the Lightweight Field at Low Cost!

Bendix-Westinghouse, long the leader in heavyweight braking now offers operators of lightweight vehicles all the proven benefits of the world's most effective and efficient braking power—AIR! Yes, regardless of how small your vehicles may be you can now enjoy the faster, smoother, surer, more effortless stops possible only with Air Brakes!

TU-FLO 300 COMPRESSOR—GIANT IN PERFORMANCE—MIDGET IN SIZE—An outstanding new Bendix-Westinghouse development, the Tu-Flo 300 Compressor makes this lightweight air brake system possible. Less than 8¾ inches high and weighing only 14 pounds, this remarkable two-cylinder reciprocating piston-type compressor retains many proven basic design features, plus a superior new unloading mechanism and new design inlet valves. It is air-cooled, quiet running, and built to operate efficiently at higher speeds. Its compactness and light weight combined with its ruggedness and high performance bring the time-proven reliability of Air Brakes to lightweight vehicle owners—offer the comforting feeling of extra safety to their drivers.

NEW TYPE "E" TREADLE BRAKE VALVE—This new unit also is specifically designed for lightweight vehicle installations. Drivers will like the "feel" of this new treadle-type valve. A slight foot depression of the comfortably angled treadle and the power of air does the work. The full graduating characteristics of the valve always provide for complete driver control of the vehicle. Smoother, surer braking results. Driver fatigue is reduced, confidence increased.

NEW AIR-HYDRAULIC ACTUATORS—A complete new line of air-hydraulic actuators permits selection of proper size and mounting to suit all hydraulic master cylinder requirements. They are compact, dirt-proof, require no lubrication and practically no maintenance.

COMPACT, LOW-COST KITS FOR EASY INSTALLATION—The new lightweight Bendix-Westinghouse Air Brake System is available in handy kits containing everything down to the last nut and bolt to make installation a cinch. There is a kit to fit any make or model lightweight vehicle.

NOW AT YOUR BENDIX-WESTINGHOUSE DISTRIBUTOR—Stop in and inspect this new system at your Bendix-Westinghouse Distributors at your first opportunity. Take a demonstration ride. You'll be convinced that for lightweight vehicles, too, the best brake is AIR and the best Air Brake is Bendix-Westinghouse.

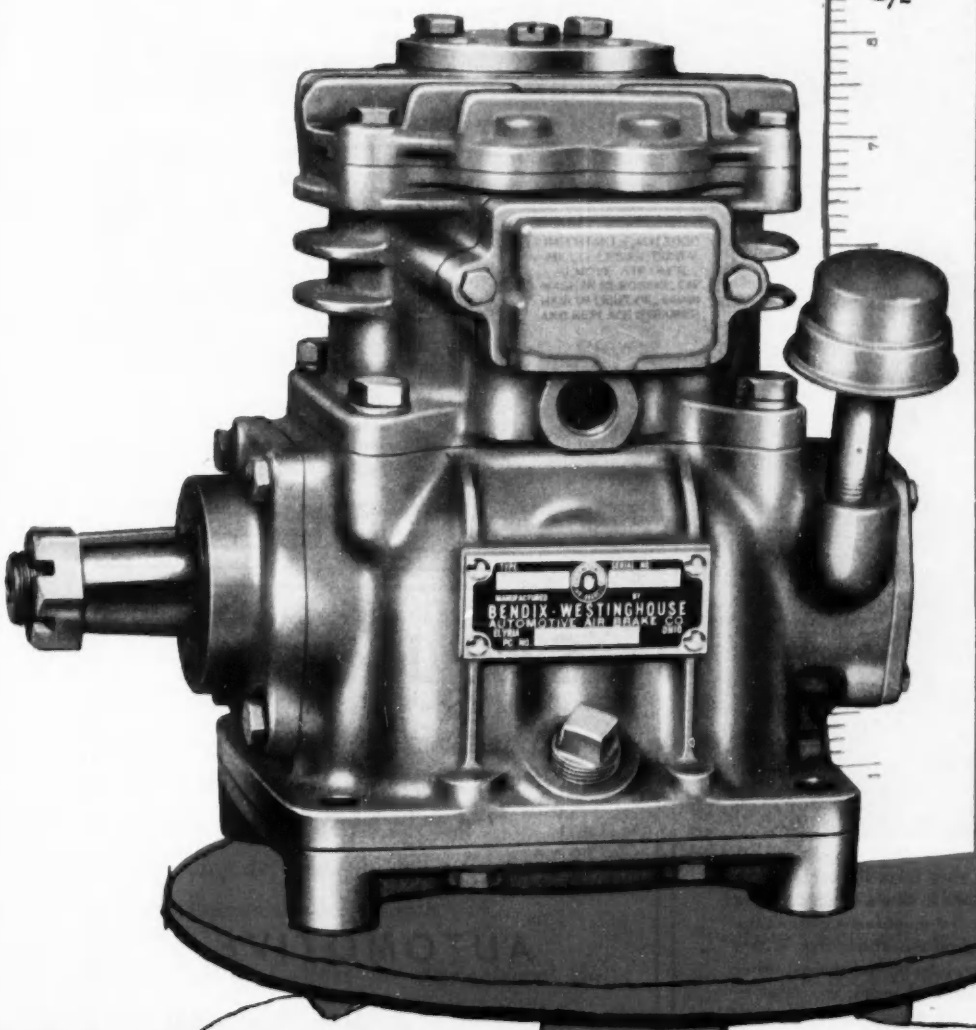
The best brake is air . . .
The best air brake is Bendix-Westinghouse

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY
GENERAL OFFICES & FACTORY: ELYRIA, OHIO • BRANCHES: BERKELEY, CALIF., OKLAHOMA CITY, OKLA.

SIMPLE, COMPACT, EASY TO INSTALL

NEW TYPE "E" TREADLE BRAKE VALVE

ANNOUNCES BRAKE SYSTEM



NEW AIR-HYDRAULIC ACTUATORS

UNITED SPECIALTIES *Expands Production Facilities to meet Increasing Customers' Needs...*

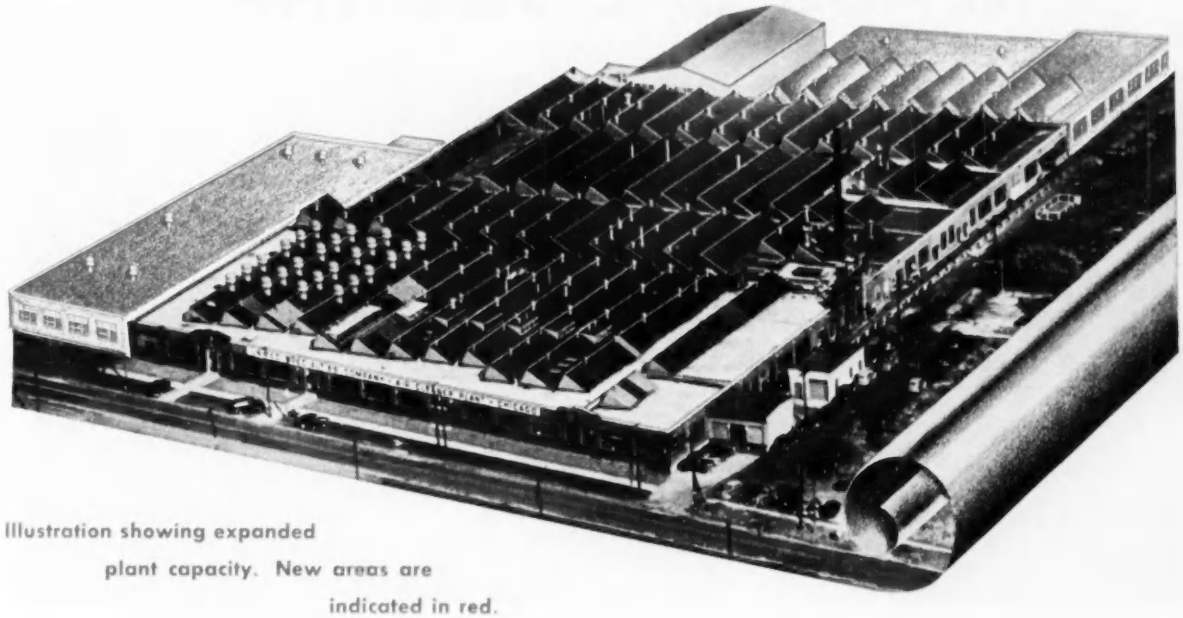


Illustration showing expanded plant capacity. New areas are indicated in red.

With plant facilities taxed to the utmost to supply an ever increasing air cleaner demand, United Specialties Company blueprints a much needed expansion program. Today, at a cost of over $900,000, improvements including 54,000 square feet of new floor space, 30 new presses and a modern, streamlined welding department are helping turn out oil bath air cleaners at a record rate.

Half a Million Dollars for Agricultural Units

Of the total appropriation, $500,000 has gone into expansion of facilities for production of agricultural air cleaners and pre-cleaners. This development has made possible entirely separate assembly lines for agricultural and automotive type air cleaners, with increased facilities for both. Today daily air cleaner production is above the 10,000 mark — an increase of approximately 20 percent.

Whatever your air cleaner requirements, United Specialties Company has the engineering experience — and the production facilities — to handle them. We invite your inquiry.

United Specialties combination oil bath air cleaner and pre-cleaner.

Hat-type cleaner used on passenger cars and trucks.

UNITED SPECIALTIES COMPANY

United Air Cleaner Division — Chicago 28 **Mitchell Division — Philadelphia 36**

Birmingham 11, Alabama

AIR CLEANERS • METAL STAMPINGS • ROLLED SHAPES
IGNITION AND TURN SIGNAL SWITCHES • DOVETAILS

LOCKHEED'S TOP ENGINEER READS SAE JOURNAL

Hall L. Hibbard, vice-president—engineering at Lockheed Aircraft Corporation (standing in center) is one of the men who regularly gets ideas and facts from SAE Journal . . . and so do many of his chief lieutenants.

Lockheed (the maker of the F-94 Starfire) is another of the 5000 aeronautic and automotive companies in which decision-making engineers read SAE Journal.

In automobile and truck companies, in plants which make airplanes, aircraft powerplants, diesel engines, road machinery, farm machinery, parts and accessories . . . everywhere that top-flight automotive engineers gather to make technical decisions, SAE Journal readers are likely to be a majority of those present.

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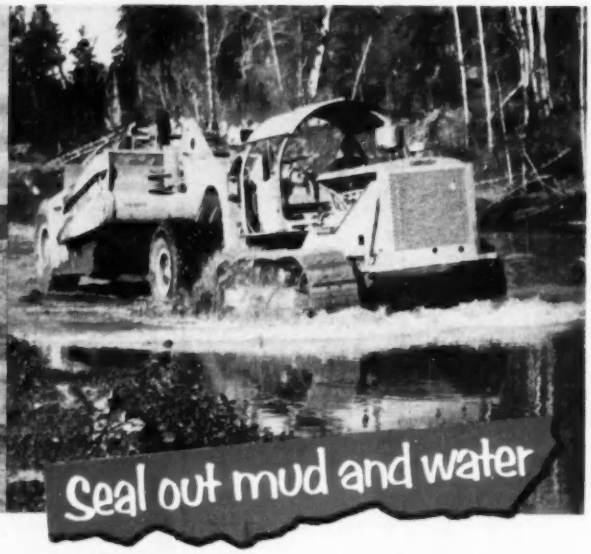

Installing a dust seal gasket between the castings in the bevel gear and steering clutch compartment of a Caterpillar track-type Tractor.

Probably tractors encounter more severe operating conditions than almost any other piece of mechanical equipment, and for that reason it is vitally important to keep dust, grit, and water out of operating parts, and oil and grease in. Felt seals are ideal for this purpose, and American is proud to supply felt for sealing to Caterpillar Tractor Co., Peoria, Illinois. In these days of expanding construction, you will see Caterpillar-built machinery everywhere. Felt is in many of them, unseen, helping protect performance, reliability, and long life . . . American makes various types of felt for sealing purposes, and supplies it as desired, including gaskets and washers cut to size. For information, write for Data Sheet No. 11, "Felt Seals, Their Design and Application."

American Felt Company

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Double Diamond GEARS are built...

. . . to produce low installed cost

. . . to serve economically and dependably on the job for which you buy them

. . . and to do credit to your product and your reputation

The above quotation appears in the introduction of our new 40-page reference book which fully describes the ten types of gears in which we specialize. If you are interested in gears built to those standards have your secretary write for a copy of the complete catalog.

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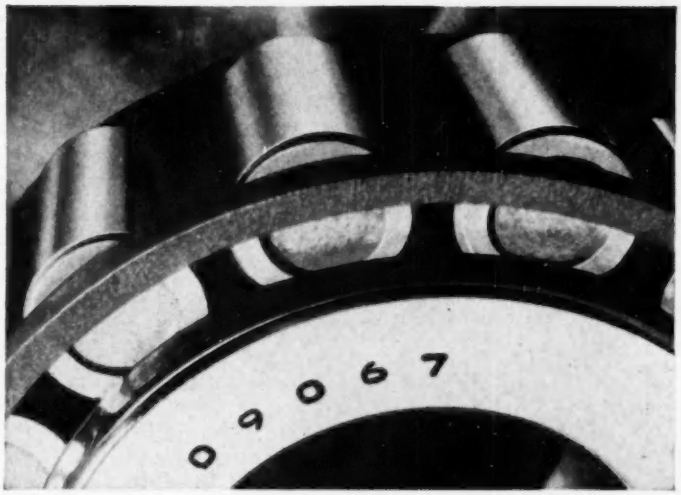
AUTOMOTIVE GEAR WORKS

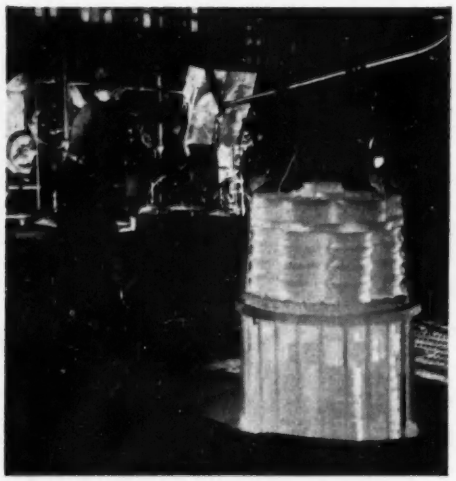
RICHMOND, INDIANA

FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS

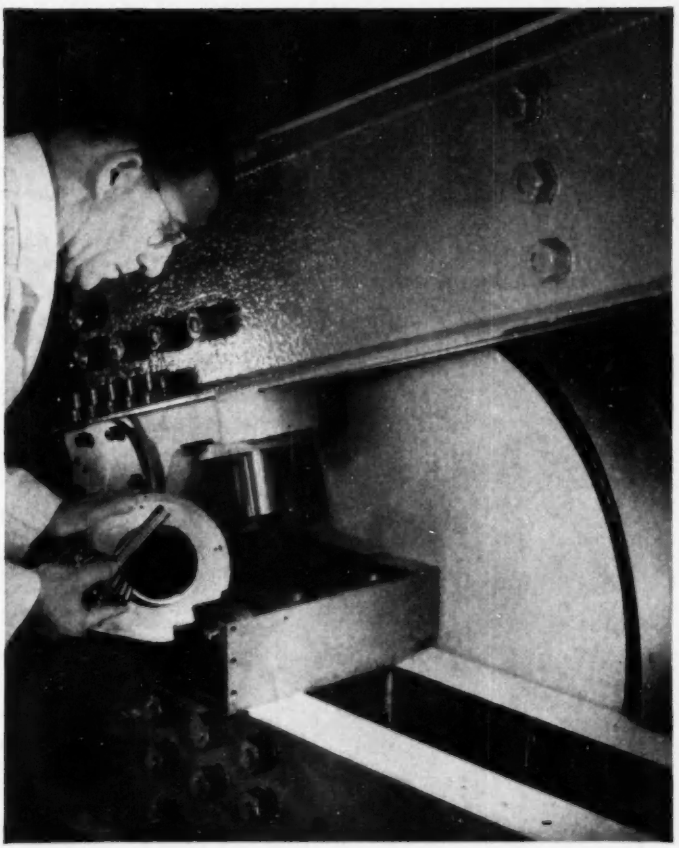
The story behind a number



The number 09067 on the bearing cone shown above—coupled with 09195 on the cup—tells a short story. It is a certain size tapered roller bearing used on front wheels. But since the trade-mark "Timken" is also stamped on the bearing, the number tells the complete story about the bearing's quality and the service that goes with it.



To case-harden every race and roller, we built the world's largest battery of carburizing furnaces, man them 168 hours a week. It's typical of the many costly extra steps that go into Timken bearings to make them the number 1 value for your car's moving parts—the vital zone.



It helps design tomorrow's bearings. Can Timken bearings be made to last even longer? A continuous, large-scale research program is helping us find out. This machine, for instance, tests the effect of vibration on bearings. It's one more reason to specify "Timken" with the bearing number. And for *full* value, always use a Timken bearing cup with a Timken bearing cone. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN is number 1 for VALUE where value counts most . . . in the vital zone

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